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STAGE 4 ARCHEOLOGICAL ASSESSMENT

Chalk River Site (includes NLBU Administrative Records)

232-509213-REPT-003

Revision 0

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286 Plant Road
Chalk River, Ontario
Canada K0J 1J0

286, rue Plant
Chalk River (Ontario)
Canada K0J 1J0

Stage 4 Archaeological Assessment

Proposed Near Surface Disposal Facility
- EMR Site -

CaGi-65 Stations I, Q, and Locale J
CaGi-66 Locale A
&
CaGi-67 Locales I, F, and Station X
Part of Lot 21, Concession Range B, Buchanan Township, Renfrew County

Prepared for:

Susan Titterington
Environmental Analyst, Environmental Protection

Canadian Nuclear Laboratories
Chalk River Laboratories
286 Plant Road
Mail Stn 84 Chalk River, Ontario K0J 1J0
Phone: (613) 584-8811 ext 46774
susan.titterington@cnl.ca

Prepared by:

Kinickinick Heritage Consulting
207 Old Mine Road
Cobden, ON K0J 1K0
Phone: 613-791-4391
email:jkenswayze@gmail.com

and

Cameron Heritage Consulting Inc.
5021-25 Civic Centre Road,
Petawawa ON K8H 0B0
Phone: (613) 281-3838
email: cameronheritageconsulting@gmail.com

PIF Numbers: P371-0009,0015, 0016-2017
Courtney Cameron (License Number P371)
September 27, 2018

EXECUTIVE SUMMARY

As part of an Environmental Assessment archaeological assessments (stages 1-3) were conducted for the proposed Near Surface Disposal Facility - EMR Site. The proposed development is approximately 33 ha in size and is located on part of Lots 20, 21 and 22, Concession Range A, and part of Lots 21, 22, and 23 Concession Range B, Buchanan Township, Renfrew County. Given the proximity to previously recorded sites and to relict Champlain Sea shorelines, the area exhibited potential for the presence for archaeological resources. The stage 2 archaeological survey was conducted between May 2016 and June 2017. The survey was conducted under PIFs P371-0008-2017, P371-0005-2016, and P039-232-2016. The survey employed the shovel pit methodology as the entire area was forested. The results of the stage 2 survey were that 422 positive test pits were recorded. A total of 1536 artifacts were recovered during the shovel testing and infilling activities. Most artifacts in the assemblage were lithics made from local sources, and were not temporally diagnostic. However, there were five historic artifacts recovered, four of which were associated with the existing site, CaGi-36, Blimkie Farm. In addition there were 23 lithic artifacts made from non-local lithic sources.

A total of 69 locations met the MTCS criteria for containing CHVI and 68 were recommended for stage 3 site assessment. One area was identified as belonging to an existing Euro-Canadian site, CaGi-36, and this area, with a 50 m buffer, was removed from the project footprint. Three archeological sites were recorded: CaGi-65, 66, and 67. Given the dispersal pattern that indicates a low level use of the entire area with pockets of concentrations, the extent of the sites was determined by topography characteristics, observed boundaries, and arbitrary boundaries.

Despite the lack of temporally diagnostic artifacts, the sites can be dated using geochronological methods. The relict shorelines of the Champlain Sea within CNL are well documented in Catto *et al* 1982 and 1983. Geochronological analysis indicates that the earliest postglacial relict shoreline dates between 10,500 to 10,000 BP. Over this period the Early Champlain Sea level fell from over 200 masl and paused briefly at 195 masl, before it reached a centuries long stasis at 180 masl and is associated with CaGi-65. CaGi-66 is associated with the postglacial relict shoreline with a geochronological date of 9,600 BP, and CaGi-67 is associated with the postglacial relict shoreline with a geochonological date of 8,500 BP.

The stage 3 site assessment for CaGi-65 was conducted between August 19, 2016 and July 11, 2017, under PIFs P039-0228-2016 and P371-0012-2017. A total of 510 lithic artifacts were recovered from 28 areas of concentration. No formal or temporally diagnostic lithic tools were recovered and all but 13 were made from local sources. A total of 305 m^2 was excavated during the Stage 3 and five of those units met the criteria determined by MTCS Standards and

Guidelines that those units that contain more than 10 artifacts contain CHVI. Therefore five units were recommended for Stage 4 Mitigation.

The stage 3 site assessment for CaGi-66 was conducted between October 31, 2016 and June 14 2017, under P039-0229-2016 and P371-0011-2017. A total of 180 lithic artifacts were recovered from 16 areas of concentration. No formal or temporally diagnostic lithic tools were recovered and all but three were made from local sources. A total of 119 m^2 was excavated during the Stage 3 and five of those units met the criteria determined by MTCS Standards and Guidelines that those units that contain more than 10 artifacts contain CHVI. Therefore five units were recommended for Stage 4 Mitigation.

The stage 3 site assessment for CaGi-67 was conducted between November 9, 2016 and June 27, 2017, under PIFs P039-0230-2016 and P371-0010-2017. A total of 469 lithic artifacts were recovered from 23 areas of concentration. No formal or temporally diagnostic lithic tools were recovered and all but 15 were made from local sources. A total of 244 m^2 was excavated during the Stage 3 and nine of those units met the criteria determined by MTCS Standards and Guidelines that those units that contain more than 10 artifacts contain CHVI. Therefore nine units were recommended for Stage 4 Mitigation.

There were a total of 19 units that contained CHVI in seven areas of concentration within the boundaries of the proposed NSDF - EMR project area. None of these areas were able to be avoided and protected; and therefore, all 19 units were subjected to stage 4 mitigation.

Within CaGi-65 there were five 1 x 1 m units in three areas of concentration that contained sufficient CHVI to require stage 4 mitigation. Fieldwork was conducted between August 10 and November 1, 2017 under PIF P371-0009-2017 issued to Courtney Cameron. A total of 118 m^2 was excavated within three areas of concentration within CaGi-65. A total of 2787 lithic artifacts were recovered and all but 15 were from local sources. The artifacts and their distribution throughout CaGi-65 indicates that this site consists of a general lithic workshop/quarry areas.

Within CaGi-66 there were five 1 x 1 m units in one area of concentration that contained sufficient CHVI to require stage 4 mitigation. Fieldwork was conducted between October 19 and October 26, 2017 under P371-0016-2017 issued to Courtney Cameron. A total of 33 m^2 was excavated within one area of concentration within CaGi-66. A total of 198 lithic artifacts were recovered and all were from local sources. The artifacts and their distribution throughout CaGi-66 indicates that this site consists of a general lithic workshop/quarry areas.

Within CaGi-67 there were nine 1 x 1 m units in three areas of concentration that contained sufficient CHVI to require stage 4 mitigation. Fieldwork was conducted between August 10 and November 1, 2017 under PIF P371-0015-2017 issued to Courtney Cameron. A total of 130 m^2 was excavated within three areas of concentration within CaGi-67. A total of 1978 lithic artifacts were recovered and all but 25 were from local sources. The artifacts and their distribution throughout CaGi-67 indicates that this site consists of a general lithic workshop/quarry areas.

CaGi-65, CaGi-66, and CaGi-67 has been fully excavated and documented to the extent required under the MTCS Standards and Guidelines. No cultural heritage value or interest remains and the locations have been fully documented and the information is preserved for future study; therefore no further archaeological work is recommended.

The Stage 4 archaeological mitigation was completed by Courtney Cameron M.A., (P371) with Cameron Heritage Consulting and Ken Swayze M.A., (P039) with Kinickinick Heritage Consulting.

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PROJECT PERSONNEL

Project Manager
Ken Swayze, M.A. P039

Archaeological Licensee
Courtney E.G. Cameron, M.A. P371

Report Author
Courtney E.G. Cameron
Ken Swayze
Marc Kelly

Project Research
Ken Swayze
Courtney E.G. Cameron

Artifact Analysis and Cataloguing
Ken Swayze
Donald Webb

Project Assessment and Analysis
Ken Swayze
Courtney E.G. Cameron

Mapping
Courtney E.G. Cameron

Project Report Review
Ken Swayze

Field Crew
Ken Swayze
Courtney E.G. Cameron - Field Director
Owen Laflamme, B.A., R1127 - Field Director
Marc Kelly
Robin Tinney - Algonquins of Ontario Liaison
Carl Ralph
Doug Lester
Glenn McLeod
Bella McLeod
Cherida Quachegan
Shannon Michaud
Dan Lapierre
Wylden Ray
Isaac Bender
Gabrielle Lavoie
Dakota Penassie,
Zan McLeod
Amanda Simeon
Alex St.louis

1. PROJECT CONTEXT

1.1. Objectives

The purpose of the stage 4 archaeological assessment is to address development impacts on an archaeological site with a level of cultural heritage value or interest that has been determined to require mitigation. There are two approaches for mitigation of development impacts are, avoidance and protection, or excavation. While, avoidance and protection is the preferred option as it preserves the archaeological site intact, avoidance was not a viable option. According the Standards and Guidelines of Consulting Archaeologists, while it may not be necessary to excavate the whole archaeological site, excavation strategies must focus on recovering as much data as possible rather than on sampling the site. Therefore, 19 1 x 1 m units identified during the stage 3 site assessment as containing sufficient CHVI were subjected to site excavation. The objectives of excavation are:

- To document the archaeological context, cultural features and artifacts for all parts of the archaeological site
- To document the removal of the archaeological site
- To preserve the information about the archaeological site for future study.

1.2. Development Context

The Chalk River Laboratories (CRL) property has an area of approximately 40 km^2 and is located on the Ottawa River about 25 km upstream from Pembroke (Figures 1 & 2). Canadian Nuclear Laboratories (CNL) is proposing to construct a long term Near Surface Disposal Facility (NSDF) on their property at Chalk River, Ontario. The NSDF is a facility designed for the management of CNL's low level radioactive waste and other suitable waste streams (CNL 2016). The site selection process has identified East Mattawa Road (EMR) site as a possible location for the facility. NSDF site EMR is approximately 30.23 ha in size and is located between Plant Road, Perch Lake and on either side of EMR. Five meters on either side of Dump Road, and sections of the EMR will be upgraded to accommodate traffic for the NSDF site. The Proposed NSDF - EMR site is located on parts of Range A, Lots 20-22 and parts of Range B Lots 20-23. This area was assessed in 2016 under PIF P371-0005-2016. In 2017 CNL added two areas to the original NSDF - EMR after the initial archaeological assessment was completed. As these areas were not assessed under the original archaeological assessment, they were assessed separately in 2017 under PIF P371-0008-2017. The two areas were added to either end of the NSDF-EMR footprint. The north area is approximately 1.59 ha in area and the south area is approximately 1.53 ha in area (Figure 3).

1.2.1. Regulatory Context

The archaeological work on the proposed NSDF - EMR site was triggered by CEAA. According to the Canadian Environmental Assessment Act (CEAA) consideration must be given to cultural heritage resources in federal environmental assessments. Every environmental assessment must consider any effects on cultural heritage resources (including any cumulative effects), resulting from a change in the environment caused by that project "any change that the project may cause in the environment, including any effects of such change..., on physical and cultural heritage, on the current use of lands and resources for traditional purposes by aboriginal persons, or on any structure, site or thing that is of historical, archaeological, paleontological or architectural significance" (Section 2(1), CEAA 2012) (Government of Canada 2012)[1].

According to the Guide for CEAA, a Cultural Heritage resource is "*a human work or a place that gives evidence of human activity or has spiritual or cultural meaning, and that has historic value. Cultural heritage resources are distinguished from other resources by virtue of the historic value placed on them through their association with an aspect(s) of human history. This interpretation of cultural resources can be applied to a wide range of resources, including, cultural landscapes and landscape features, archaeological sites, structures, engineering works, artifacts and associated records*" (Government of Canada 2016).

Kinickinick Heritage Consulting was retained by Canadian Nuclear Laboratories to undertake the Stage 1, 2, 3, and 4 Archaeological Assessments in accordance with the requirements of *CEAA*. Permission to access the property and remove any artifacts encountered was given by Susan Titterington, Environmental Analyst, Environmental Protection of Canadian Nuclear Laboratories[2].

The stage 4 excavations within the NSDF-ERM site was conducting according to the requirements of the Ministry of Tourism, Culture, and Sport's *Standards and Guidelines for Constant Archaeologists* (MTCS 2011). All documents, and records will be curated at the offices of Kinickinick Heritage Consulting and Cameron Heritage Consulting. The artifacts will be curated at the Kinickinick Heritage Consulting storage facility until such time that they can be permanently curated at The Algonquin Way Museum in Pikwakanagan.

1 *Section 7.5.6 Standard 1 MTCS Standards and Guidelines*

2 *Section 7.5.6 Standard 3 MTCS Standards and Guidelines*

2. Historical Context

The majority of the background research that describes the past and present land use and the settlement history and any other relevant historical information was gathered during the stage 1 and 2 archaeological assessments for this project and therefore refer to this section in the reports titled "*Stage 1 & 2 Archaeological Assessment, Proposed Near Surface Disposal Facility - EMR Site - Lots 20, 21, and 22, Concession Range A and B, Buchanan Township, Renfrew County*" PIF P371-0005-2016 dated April 29, 2018 (Cameron 2017), and "S*tage 1 & 2 Archaeological Assessment, Proposed Near Surface Disposal Facility - EMR Site - Additional Areas. Lots 20, 22, and 23, Concession Range B, Buchanan Township, Renfrew County*" PIF 371-0008-2017 dated May 15, 2018 (Cameron 2018).

Given that there were no post-contact archaeological sites documented during the stage 4 site excavation, there is no historical documentation to accompany this section section[3].

3. ARCHAEOLOGICAL CONTEXT

3.1. Existing Archaeological Sites[4]

According to the Borden (1952) system of archaeological site registration used by Ontario, CRL is in the CaGi "Borden Block" (a rectangular area, about 13 x 19 km) that straddles both sides of the Ottawa River. Borden blocks use a four letter designation system, and the sites within the block are numbered sequentially as they are registered. Prior to the CRL cultural resource inventory and property inspection (carried out from 2006 to 2007), there were 14 archaeological sites recorded in the CaGi block but only two in CRL. Since the completion of an archaeological master plan in 2008, the number of registered sites in CRL approaches 65.

The Ontario Ministry of Tourism Culture and sport maintain a database that contains archaeological sites that were registered using the Borden system. A review of the MTCS archaeological sites database and existing reports was conducted and there are 18 registered archaeological sites within 2 km of the PDA (Table 1). There are three archaeological sites that are immediately adjacent to the PDA as they were recorded during the stage 1 & 2 archaeological assessment of the original NSDF - EMR footprint. Approximately ⅔ of the sites are aboriginal in nature, while ⅓ are historic.

3 Section 7.5.7 Standard 1 MTCS Standards and Guidelines

4 Section 7.5.8 Standard 1 MTCS Standards and Guidelines

Table 1: Archaeological Sites located within 2 km of the PDA

Borden Number	Site Name	Time Period	Affiliation	Site Type	PIF
CaGi-7	Pointe au Bapteme	Woodland, Post-Contact	Aboriginal, Euro-Canadian	camp / campsite	P039-167-2011, P039-115-2007, 1993-040(NOCI F#)-1
CaGi-30	Arthur Beauchamp Homestead	Post-contact	Euro-Canadian	homestead	P039-115-2007
CaGi-31	Bob Chequen Homestead and Whiskey Still	Post-contact	Euro-Canadian	homestead	P039-093-2006, P039-187-2012, P039-198-2013
CaGi-33	McLeod Homestead	Post-Contact	Euro-Canadian	homestead	P039-115-2007
CaGi-35	Millar's Cottage	Post-Contact	Euro-Canadian	homestead	P039-115-2007
CaGi-36	Felix Beauchamp Homestead	Post-Contact	Euro-Canadian	homestead	
CaGi-37	Blimkie Farm	Post-Contact	Euro-Canadian	homestead	
CaGi-40	Parking Lot	Archaic, Early	Aboriginal		
CaGi-52	Communications Tower	Pre-contact	Aboriginal	workshop	P039-138-2008
CaGi-53	Parking Lot	Pre-contact	Aboriginal	workshop	P039-115-2007
CaGi-54	South Shore	Pre-contact	Aboriginal	workshop	P039-115-2007
CaGi-56	Bore Hole 58	Archaic, Early	Aboriginal	camp / campsite	P039-214-2014
CaGi-57	Bore Hole 59	Archaic, Early	Aboriginal	Otherlook-out, camp / campsite	P039-214-2014
CaGi-58	Bore Hole 50	Archaic, Early	Aboriginal	camp / campsite	P039-214-2014

Borden Number	Site Name	Time Period	Affiliation	Site Type	PIF
CaGi-59	Bore Hole 52	Archaic, Early	Aboriginal	camp / campsite	P039-214-2014
CaGi-60	Bore Hole 48	Archaic, Early	Aboriginal	beach, camp / campsite, scatter, workshop	P039-214-2014
CaGi-63	Area D pit house	Archaic, Early	Aboriginal	Other possible pit-house	P039-173-2011
CaGi-64	Big Marsh Quartz Extraction	Archaic, Early	Aboriginal	quarry, scatter, workshop	P039-173-2011
CaGi-65	Upper NSDF	Pre-contact	Aboriginal		P371-0005-2016, P371-0008-2017
CaGi-66	Middle NSDF	Pre-contact	Aboriginal		P371-0005-2016, P371-0008-2017
CaGi-67	Lower NSDF	Pre-contact	Aboriginal		P371-0005-2016, P371-0008-2017

In addition there was a site located at the National Research Universal (NRU) reactor site which was discovered by Clyde Kennedy in 1955 in a sand deposit, about 3 m above the waterline, near the NRU reactor (Kennedy 1970). It does not exist anymore. Kennedy did not assign a borden number to the site, as the borden numbering system was not yet in use, and the disposition of the artifacts is uncertain, although they may be at the Canadian Museum of Civilization. Bone, pottery sherds, and chert flakes were found in an area about 15 x 60 m, mostly from a disturbed context, although one intact refuse pit was excavated. The pottery was diagnostic of Middle Woodland (Point Peninsula) activity about 2,000 years ago.

3.2. Existing Conditions[5]

The PDA is located on the leeward site of a fossil island and slopes down to the southwest. Three relict shorelines of the Champlain Sea occur within the PDA. The entire area is forested with the exception of areas that have been impacted by development (hydro corridors, roads, tree plantations). The soil is a typical boreal forest podzol, with a thin elluviated A-horizon. The soil texture is a very sandy matrix with local lithic clasts and can be around one meter deep. The

5 Section 7.5.8 Standard 3, MTCS Standards and Guidelines

area is scattered with bedrock outcrops. Bedrock is primarily gneiss and feldspar pegmatite. More detailed existing conditions can be found in the Stage 1 & 2 Archaeological Assessment reports and the Stage 3 Site Assessment reports (Swayze 2017a, and b, and Cameron 2017, 2018a and b).

3.3. Dates of Fieldwork[6]

The Stage 4 site mitigation work began May 16, 2017 and ended November 26, 2017.

3.4. Previous Archaeological Work[7]

A review of the MTCS archaeological reports database, there are nine reports that detail archaeological work that was carried out within 2 km of the PDA (Table 3).

Table 4: Reports of archaeological work carried out within 2 km of the PDA

PIF	Distance from PDA	Title	Results and Recommendations
P039-115-2007	Within and adjacent	Archaeological Assessments at Chalk River Laboratories, Buchanan Township (Geo.), Renfrew County. Inventory of Known Cultural Resources, Cultural Resource Management Projects, Archaeological Predictive Model, and Master Plan,	Potential model and AMP for CNL Chalk River location.
P002-311-2012	Crosses Lot 23 Con Range B.	Stage 1 Archaeological Assessment Pipeline to Serve CNL Chalk River Facility	Stage 2 recommended
P039-187-2012	Located in Lot adjacent to the PDA	Stage 2 Assessment of Parts of Lots 24&25 Range B. The Stack Road Section of the Domestic Waterline Route.	CaGi-31 - Stage 3 CaGi-59 - Stage 3
P039-180-2012	Located within Lot 21 Range B	Storm Sewer Stage 2	Artifacts noted, but NFW recommended.
P039-198-2013	Located two lots away.	Stage 3 Assessment at CaGi-31 Chequen, on part of Lot 25 Range B.	Avoidance of the untouched part of the site.

6 Section 7.5.8 Standard 3, MTCS Standards and Guidelines

7 Section 7.5.8 Standard 4 of the MTCS Standards and Guidelines

PIF	Distance from PDA	Title	Results and Recommendations
P039-210-2013	Located in Lot adjacent to the PDA	Stage 3 AA on the Original Proposed Alignment and Alternative 2 Routes	CaGi-57 NFW CaGi-60 Stage 4
P039-214-2014	Located in Lot adjacent to the PDA	Stage 1&2 AA of the Alternative 2 Route	CaGi-56 Stage 3 CaGi-57 Stage 3 CaGi-58 Stage 3 CaGi-59 Stage 3 CaGi-60/61 Stage 3
P415-0056-2015	Crosses Lot 23 Con Range B.	Stage 2 AA: Pipeline to Serve CNL Chalk River Facility	NFW
P371-0005-2016	Adjacent	Stage 1 & 2 AA Proposed NSDF - EMR Site -	CaGi-65 Stage 3 CaGi-66 Stage 3 CaGi-67 Stage 3
P039-0228-2016	Within	Stage 3 Assessment Proposed NSDF - EMR Site CaGi-67	CaGi-67 Station X: Stage 4
P039-0229-2016	Within	Stage 3 Assessment Proposed NSDF - EMR Site CaGi-66	NFW
P039-0230-2016	Within	Stage 3 Assessment Proposed NSDF - EMR Site CaGi-65	CaGi-65 Stations I and Q: Stage 4
P039-0232-2016	Within and adjacent	Stage 1 &2 AA proposed upgrades to EMR	NFW
P371-0008-2017	Within	Stage 1 & 2 AA Proposed NSDF - EMR Site - Additional Areas	CaGi-65 update, Stage 3 CaGi-66 update, Stage 3 CaGi-67 update, Stage 3
P371-0010-2017	Within	Stage 3 AA: Proposed Additional Areas, NSDF - EMR- CNL CaGi-67	CaGi-67 Stations F and I: Stage 4
P371-0011-2017	Within	Stage 3 AA: Proposed Additional Areas, NSDF - EMR- CNL CaGi-66	CaGi-66 Station A: Stage 4
P371-0012-2017	Within	Stage 3 AA: Proposed Additional Areas, NSDF - EMR- CNL CaGi-65	CaGi-65 Station J: Stage 4

3.5. Previous findings and recommendations relevant the the current stage of work[8].

The following is a review of the previous findings and recommendations that are relevant to the Stage 4 Mitigation. The Stage 1 & 2 for the PDA was conducted under two PIFs (P371-0005-2016 and P371-0008-2017). Over 10,000 shovel test pits were dug at 5 m and 10 m intervals over 95% of the PDA. A total of 422 of the shovel test pits produced archaeological material. Artifact distribution was generally low in density, but consistent throughout the entire PDA. Given that the project is located on a natural landform, a fossil island, that contains three relict shorelines of the Champlain Sea, three distinct sites were recorded for each relict shoreline, CaGi-65, CaGi-66, and CaGi-67. The sites, CaGi-65, 66, and 67, are based on the natural site boundaries of the relict shorelines, observed site boundaries, and arbitrary site boundaries. Within the sites, artifact clusters were assigned an alphabetical letter and a 'Station' name if work was conducted in the original PDA or a 'Locale' name if the work was conducted in the additional areas of the PDA. Thus CaGi-65 Locale J, Station Q, and Station I are distinct areas of artifact concentration above 180 m asl. Within CaGi-65 there are 28 areas of concentration (Stations A-Y and Locales J-L), that met the definition of having cultural heritage value or interest with an artifact concentration that met or exceeded 5 artifacts within a 10 m area. Within CaGi-66, 16 areas (Stations A-L and Locales A-C, and G), met the definition of having cultural heritage value or interest with an artifact concentration that met or exceeded 5 artifacts within a 10 m area. Within CaGi-67, 24 areas (Stations A-R, and X and Locales D-F, H, and I) met the definition of having cultural heritage value or interest with an artifact concentration that met or exceeded 5 artifacts within a 10 m area. These 68 areas were recommended for stage 3 site assessment. The artifact assemblage consisted of expedient or informal tools made from locally sourced lithic material. No diagnostic artifacts were recovered; nevertheless, this is the kind of local Archaic adaptation one would expect. The association with relict shorelines provides a geochronological age of occupation, and its is consistent with the Gulf of Maine Archaic tradition

The Stage 3 site assessment for CaGi-65 was conducted under two PIFs (P039-0228-2016 and P371-0012-2017). A total of 305 m^2 was excavated and a total of 510 artifacts were recovered. All artifacts were pre-contact lithics. No formal or temporally diagnostic lithic tools were recovered and all but 13 were made from local sources. According to the Standards and Guidelines for Consultant Archaeologists Section 3.4.1 Standard 1a: Cultural Heritage Value or Interest is present and requires Stage 4 Mitigation of Development when one or more test units yields 10 or more artifacts. A total of five units within CaGi-65 met this criteria, two contiguous units at

8 Section 7.5.8 Standard 5 of the MTCS Standards and Guidelines

Locale J, one unit at Station Q, and two units at Station I. Therefore five units were recommended for Stage 4 Mitigation.

The Stage 3 site assessment for CaGi-66 was conducted under two PIFs (P039-229-2016 and P371-0011-2017). A total of 119 m^2 was excavated and a total of 180 lithic artifacts were recovered. All artifacts were pre-contact expedient lithics. No formal or temporally diagnostic lithic tools were recovered and all but three were made from local sources. According to the Standards and Guidelines for Consultant Archaeologists Section 3.4.1 Standard 1a: Cultural Heritage Value or Interest is present and requires Stage 4 Mitigation of Development when one or more test units yields 10 or more artifacts. At Station A five units met this criteria. Therefore five units were recommended for Stage 4 Mitigation.

The Stage 3 site assessment for CaGi-67 was conducted under two PIFs (P039-0230-2016 and P371-0010-2017). A total of 244 m^2 was excavated and a total of 469 artifacts were recovered. All artifacts were pre-contact expedient lithics. No formal or temporally diagnostic lithic tools were recovered. According to the Standards and Guidelines for Consultant Archaeologists Section 3.4.1 Standard 1a: Cultural Heritage Value or Interest is present and requires Stage 4 Mitigation of Development when one or more test units yields 10 or more artifacts. A total of nine units within CaGi-67 met this criterial six units at Locale F, one unit at Locale I, and two units at Station X. Therefore nine units were recommended for Stage 4 Mitigation.

4. FIELD METHODS

Stage 4 archaeological assessment entails either the preservation and protection (the preferred choice when feasible) or controlled excavation to remove the archaeological deposit. As avoidance and protection of the archaeological deposits at NSDF-EMR Site was not possible, the sites were excavated through controlled removal and recording of the context, cultural features and artifacts, and the cultural heritage value or interest of the archaeological site was documented.

During the stage 3 site assessment, datums and 5 x 5 m grids were established and this grid was used to excavate the stage 4 mitigation. The stage 3 site assessment 1 x 1 m excavation units that were determined to contain CHVI (produced 10 or more artifacts during the stage 3 process) were expanded. This entailed controlled excavation of all surrounding units, (eight contiguous grid units). The excavation units were excavated with shovels and trowels in 10 cm levels and excavation of the units stopped at either the parent material, which occurred at depths up to 1.2 m below surface, or when there was at least one 10 cm level that did not produce artifacts. If, during the Stage 4 excavation, any of the units produced, at a minimum, ten artifacts of any kind, then additional units are required to be excavated around the unit until the number of artifacts, in any excavation unit, fell below the threshold (10 artifacts). This continued until all units along the border of the excavation contained less than 10 artifacts. If a feature was uncovered, then 2 m (2 excavation units) must be excavated. However, no features were uncovered during the mitigation process.

As the sites were recorded on palaeo shorelines of the Champlain Sea which date to the Archaic, 20% of the units were screened through 3mm mesh, while the rest was screened through 6mm mesh[9]. With the permission of Ms.Titterington, the finished grid units were left open.

As per Section 7.11.1 field methods of the MTCS Standards and Guidelines for Consultant Archaeologists, there are general requirements for the excavation of archaeological sites. Below is a table with detailed and explicit descriptions on how each standard was addressed for stage 4 mitigation.

Standard		
7.11.1.a	Confirm that the fieldwork was conducted according to the archaeological fieldwork standard and guidelines, including those related to weather and lighting conditions.	All fieldwork was conducted according Section 4.2.1 General requirements for the excavation of archaeological sites of the Standards and Guidelines for Consulting Archaeologists. Excavations at CaGi-65 were conducted between August 10, 2017 and November 1, 2018. The weather ranged from 10 to 32°C. (Photographs 1 - 8) Excavations at CaGi-66 were conducted between October 19, 2017 and October 26, 2017. The weather ranged from 16 to 18°C. (Photographs 9, and 10) Excavations at CaGi-67 were conducted between July 24, 2017 and November 15, 2017. The weather ranged from -5 to 32°C. The temperatures plummeted at the end of November and the ground started to freeze. To prevent freezing and snow cover, the open excavation areas and proposed units were covered with 1⁄2” styrofoam insulation and tarpaulins when not being excavated to prevent freezing (Photographs 11 - 20).

9 Section 4.2.2 Standard 5 MTCS Standards and Guidelines for Consultant Archaeologists

Standard		
7.11.1.b	Provide GPS coordinates of the datum location and a description of the site grid.	Provided in appendix B with sensitive information (Figures 5 - 20)
7.11.1.c	Describe the decisions made in the field regarding the determination of the placement of excavations and the extent of excavations.	For every unit that yielded 10 or more artifacts, the surrounding 8 contiguous units were excavated to a depth where no more artifacts were recovered for at least one 10 cm level. This procedure continued for every unit with 10 or more artifacts. If a unit yielded less than 10 artifacts, no further units were opened.
7.11.1.d	Where appropriate, describe methods used to remove topsoil or fill, including the machinery used and the monitoring of topsoil or fill removal.	All excavation was conducted by hand using shovels and trowels. No mechanical removal of topsoil or fill was conducted.
7.11.1.e	For partial excavations, describe the methods used to shore up the exposed edges of any intact deposits before backfilling.	The deposits were completely excavated, so there was no partial excavation.
7.11.1.f	Describe the methods used to record and map the following: i) settlement patterns, artifact contexts and stratigraphy ii) cultural feature plan and profiles iii) deeply buried or previously undisturbed sites	Artifact context was recorded by unit and level. No cultural features were noted. The depth of the units varied as excavation continued until there was at least one 10cm level with no artifacts. Profiles of each Station or Locale were taken and site maps of every excavation were produced (Appendix B; Figures 5 - 20).

5. Record of Finds

5.1. Features and piece plotting[10]

There were no features (non-moveable elements of an archaeological site, such as middens, hearths, and walls) uncovered during excavations, so this standard does not apply. The lack of cultural features is common problem in Ontario with sites of this age, due to bioturbation and leaching.

10 Section 7.11.2 Standard 1 and 2 MTCS Standards and Guidelines for Consultant Archaeologists

Given the extent of bioturbation at NSDF-EMR, piece plotting for artifact concentrations or specific classes of artifacts were not conducted. Therefore this standard does not apply.

5.2. Provide catalogue and description

In the artifact catalogue, the debitage category has been expanded to include: split pebbles/ cobbles, as well as fragments, and all types of flakes/flake fragments. The informal lithics category is divided into cores, bifaces and expedient tools. The expedient tools subcategory includes any lithic that has been retouched or modified such as worked cobbles/pebbles, notched and spurred pieces. Other than this, the artifacts have not been categorized to named by implied function, since they are all informal or expedient in nature. The debitage, detritus, waste, are pieces discarded by the mechanics. Nevertheless this waste provides the archaeologist with insight into the lithic technology. Below is Table 5 outlining the different types of artifacts and their frequencies within the areas of concentration.

Table 5: Artifact type by locale

Area	Total number of lithic artifacts	Lithic debitage	Informal lithics			Other lithics (ground, pecked, polishedm, or other stone objects)
			Cores	undiagnostic Bifaces	Expedient tools (retouched or modified)	
CaGi-65 Station I	1858	(1318) 71%	(47) 2.5%	(1) 0.5%	(487) 26%	(5) 0.2%
CaGi-65 Station J	182	(108) 59.3%	(2) 1.1%	0	(72) 39.6%	0
CaGi-65 Station Q	747	(530) 71%	(10) 1.3%	0	(206) 27.6%	(1) 0.1%
CaGi-66 Locale A	198	(126) 63.6	(1) 0.5%	(1) 0.5%	(70) 35.4%	(5) 0.5%
CaGi-67 Locale F	1092	(603) 55.2%	(30) 2.7%	0	(454) 41.6%	(5) 0.5%
CaGi-67 Locale I	153	(87) 56.9%	(4) 2.6%	(1) 0.6%	(59) 38.6%	(2) 1.3%
CaGi-67 Station X	733	(509) 69.4%	(15) 2.1%	0	(208) 28.4%	(1) 0.1%

In terms of raw material, the catalogue is predominantly"granitic" in composition; however, in the catalogue the materials are differentiated by the terms: granite, gneiss, pegmatite, and schist. The first three are chemically similar, since feldspar and quartz grains are predominate; however, granite is composed of small uniform-sized grains, just visible to the eye; while pegmatite is made of "giant" crystals over 10 cm in size; and gneiss displays lineation or flow lines. Schist is similar to gneiss but has visible "schistocity" (a tendency to cleave along parallel layers). The remaining specimens are made from: crystal quartz and feldspar (probably obtained from the pegmatite sources); andesite, diorite, porphyry, and trachyte, which are most likely gneisses (D. Pucciarelli Ayllon, pers com 2018), and argillite and greywacke. Most of the materials are present locally in the parent material and bedrock; however, the greywacke and argillite are not found locally (D. Pucciarelli Ayllon, pers com 2018). Table 6 below breaks up the material distribution according to area of concentration.

Table 6: Raw material type by locale

Locale	CaGi-65 Station I	CaGi-65 Locale J	CaGi-65 Station Q	CaGi-66 Locale A	CaGi-67 Locale F	CaGi-67 Locale I	CaGi-67 Station X
Total number of lithic artifacts	1858	182	747	198	1092	153	733
Andesite	16		4		2	1	4
Argilite	7	3			10	7	4
Basalt	1						
Conglomerate			1				
Diorite	9		1		1	3	2
Feldpar	4		4	1	11		7
Gneiss	456	35	170	61	112	17	65
Granite	1238	144	485	85	865	115	622
Greenstone			1				
Greywacke	5				2		2
Pegmatite	62		60	43	35	3	8
Porphyry					7		
Quartz	35	2	8	5	28	5	13
Schist	10			3	16	1	4

Locale	CaGi-65 Station I	CaGi-65 Locale J	CaGi-65 Station Q	CaGi-66 Locale A	CaGi-67 Locale F	CaGi-67 Locale I	CaGi-67 Station X
Trachyte	12		10		3	1	2
Unknown	3	1					

5.3. Settlement and site function patterns.

The Stage 3 site assessments conducted in 2016 and 2017 identified seven areas within the NSDF site that contained sufficient artifact concentrations be considered to contain Cultural Heritage Value or Interest (CHVI) to warrant Stage 4 site preservation or mitigation (Figure 4). All seven areas with CHVI were composed of lithic artifact concentrations with high densities (more than 10 artifacts from a single 1 x 1 m area).

5.3.1. CaGi-65

Station I is an area of artifact concentration located in the southwest centre area of CaGi-65. Located on the highest point of the fossil island, this station initially consisted of two 1 x 1 m units (7s14w and 9s28w) from the stage 3 site assessment that produced more than 10 artifacts from the excavation of the soil and first 5 cm of subsoil.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit 9s28w (Photographs 1 & 2). The units were dug in 10 cm levels and excavation of the units stopped at either the parent material or when there was at least one 10 cm level that did not produce artifacts. Excavation in most units extended to approximately 40 cm below surface. Only one of the eight units (9s27w) produced 10 or more artifacts (a total of 38 artifacts) and required expansion. Subsequently, an additional three units were opened. None of the expanded units produced sufficient numbers of artifacts to keep expanding the excavation area. The original stage 3 unit, 9s28w, was excavated beyond the 5 cm subsoil at 10 cm levels until parent material or a lack of artifacts in one 10 cm level. An additional 42 lithic artifacts were recovered. A total of 16 units were excavated around 9s28w in an area approximately 5 x 4 m. The artifacts are concentrated along the base of a garnet gneiss bedrock outcrop, and no vertical distribution of artifacts was noticed in these units.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit, 7s14w (Photographs 3 & 4). All units were dug in 10 cm levels and excavation of the units stopped at either the parent material or when there was at least one 10 cm level that did not produce artifacts. Excavation in most units extended to approximately 100 cm below surface. All of the eight excavation units around 7s14w produced 10 or more artifacts. Subsequently, these units were expanded, and an additional 16 units were excavated. Of these 16 units, six units (9s16w, 9s14w, 9s12w, 7s12w, 6s12w, and 5s12w) produced 10 or more lithic artifacts. Therefore, an additional 13 units were excavated. Of these 13 units, three units (3s11w, 4s11w, and 6s11w) produced 10 or more artifacts. These three units were expanded and nine additional units were excavated. None of the nine units produced 10 or more artifacts and no further units were excavated. A total of 52 units were excavated around 7s14w in an area approximately 9 x 10 m. The artifacts are concentrated along the base of a garnet gneiss bedrock outcrop and are distributed with increasing count with respect to depth until 70 cm dbs when the artifact counts drop off by half.

Given the distribution and concentration of the lithic artifacts along the base of a garnet gneiss bedrock outcrop and the lack of site features, the area is considered a lithic workshop/quarry area. Palaeogeographically, this area is the relict shoreline the Champlain Sea, and there are a large number of expedient tools that were recovered, and as such this area was probably also used as a processing area which contained the raw lithics source.

Locale J: Is an area of artifact concentration located in the northern part of CaGi-65 (Photograph 5 & 6). It initially consisted of two 1 x 1 m contiguous units (5n14e and 4n14e) from the stage 3 site assessment that produced more than 10 artifacts excavated from the the soil and first 5 cm of the subsoil.

Ten contiguous 1 x 1 m units were excavated around the stage 3 units, 5n14e and 4n14e. All units were dug in 10 cm levels and excavation stopped at either the parent material or when there was a least one 10 cm level that did not produce artifacts. Excavation in most units extended to 120 cm below surface. None of the ten units produced 10 or more artifacts. The two original stage 3 units were excavated beyond the 5 cm subsoil at 10 cm levels until parent material or a lack of artifacts in one 10 cm level. An additional nine artifacts were recovered from 5n14e and an addition 77 artifacts were recovered from 4n14e. A total of 10 units were excavated around 5n14e and 4n14e in an area approximately 4 x 3m. There are two vertical distribution concentrations at this station. The first is between 20 and 50 cm and the second is between 70 and 100 cm, which correlates to a change in matrix within the soil profile at each of these depths. This could be a by-product of natural soil forming processes and bioturbation rather than two distinct occupation periods. There is no buried paleosol present that would indicate that at any point in the past the landform (relict shoreline) was stable for long enough to develop soil.

Given the concentration of the lithic artifacts to two units in the centre of the excavation, this area was probably a small workshop area.

Station Q: Is an area of artifact concentration located along the southern edge of CaGi-65 and is within 25 m of the 180 m asl relict shoreline (Photographs 7 & 8). It initially consisted of a single

1 x 1 m unit from the stage 3 site assessment which produced more than 10 artifacts from the soil and first 5 cm of subsoil (6e11s).

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit, 6e11s. All units were dug in 10 cm levels and excavation stopped at either the parent material or when there was at least one 10 cm level that did not produce artifacts. Excavation in most units extended to 50 cm dbs. The original stage 3 unit (6e11s) was excavated beyond the 5 cm subsoil in 10 cm levels until bedrock was encountered. An additional 10 artifacts were recovered. Seven of the eight excavation units produced 10 or more artifacts and therefore an additional 16 excavation units were dug. Of those 16 excavation units only the west, south and east units produced at least 10 or more artifacts. Therefore, an additional 11 units were excavation, none of which produced sufficient artifact counts to keep expanding the grid. A total of 36 1 x 1 m units were excavated within a 6 x 7 m area. The artifacts are concentrated along the base of a bedrock outcrop that contained seams of pegmatite, and no vertical distribution of artifacts was noticed in these units.

Given the concentration of the lithic artifacts along the bedrock outcrop, this area was probably a workshop or quarry area. The bedrock contained seams of pegmatite that was composed of large quartz crystals. In this area, where the local lithic options are generally of poor quality, the source of quartz would have been an important resource and would have been visible from the water.

5.3.2. CaGi-66

<u>Locale A</u> is an area of artifact concentration located along the northern edge of the PDA in the western end of site CaGi-66 (Photographs 9 & 10). It initially consisted of five 1 x 1 m units (0n15e, 0n19e, 1s19e, 9s15e, and 4s29e) from the stage 3 site assessment that produced more than 10 artifacts within the the soil and first 5 cm of the subsoil.

Five contiguous 1 x 1 m units were excavated around the stage 3 unit, 0n15e. All units were dug in 10 cm levels and excavation stopped at either the parent material or when there was at least one 10 cm level that did not produce artifacts. The original unit was already excavated to bedrock, so no additional artifacts were recovered. Only five units were dug around 0n15e, instead of eight as the northern three units were outside the PDA. Excavation in the units extended to approximately 50 cm dbs where bedrock was encountered. None of the five 1 x 1 m units produced sufficient artifacts (10 or more) to require further expansion. The original stage 3 unit, was already excavated to bedrock, so no further artifacts were obtained. No vertical distribution of artifacts was noticed in these units.

Seven contiguous 1 x 1 m units were excavated around the stage 3 units, 0n19e and 1s19e. All units were dug in 10 cm levels and excavation stopped at either the parent material or when there was at least one 10 cm level that did not produce artifacts. Only seven units were dug around 0n19e and 1s19e, instead of 10 as the northern three units were outside of the PDA. Excavation in the units extended to approximately 40 cm dbs where pegmatite bedrock was encountered. None of the seven 1 x 1 m units produced sufficient artifacts (10 or more) to require further expansion. The original stage 3 units (0n19e, and 1s19e) was already excavated to bedrock, so no further artifacts were obtained. No vertical distribution of artifacts was noticed in these units.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit, 4s29e). All units were dug in 10 cm levels and excavation stopped at either the parent material or when there was at least one 10 cm level that did not produce artifacts. Excavation in the units extended to approximately 50 cm dbs where pegmatite bedrock was encountered. None of the eight 1x1 m units produced sufficient artifacts (10 or more) to require further expansion. The original stage 3 unit (4s29e) was already excavated to bedrock, so no further artifacts were obtained. No vertical distribution of artifacts was noticed in these units.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit 9s15e. All contiguous units were dug in 10 cm levels and excavation stopped at either the parent material or when there was at least one 10 cm level that did not produce artifacts. Excavation in the units extended to approximately 60 cm dbs where pegmatite bedrock was encountered. None of the eight 1 x 1 m units produced sufficient artifacts (10 or more) to require further expansion. The original stage 3 units (9s15e) was already excavated to bedrock, so no further artifacts were obtained. No vertical distribution of artifacts was noticed in these units.

The artifact distribution shows six areas of low density lithic concentrations. Given the lack of features and the low density distribution pattern, no distinct functional areas were discernible. The station is a general purpose quarry and lithic production area.

5.3.3. CaGi-67

Locale F is an area of artifact concentration located along the north side of the EMR in the west end of CaGi-67 (Figures 4, 5, and 8, Photographs 11, 12, 19, and 20). It is located approximately 20 m west of Locale "I". Due to the forested nature of the area, they were assigned two separate grids. The area initially consisted of six 1 x 1 m units (5s0e, 6s4e, 5s5e, 6s6e, 0s5e, and 0s10e) from the stage 3 site assessment that produced more than 10 artifacts from the soil and first 5 cm of subsoil.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit, 5s0e. All units were dug in 10 cm levels and excavation stopped at either the parent material, or when there was at least one 10 cm level that did not produce artifacts. Excavation in the units extended to approximately 100 cm dbs to the parent material, a hard packed dark grey medium sand with a large amount of pebbles and cobbles. Three of the 1x1 m units produced sufficient artifacts (10 or more) to require further expansion. An additional 11 1x1 m units were excavated; however, none of the additional units produced sufficient artifacts to require further expansion.

Fifteen contiguous 1 x 1 m units were excavated around the stage 3 units, 6s4e, 5s5e, and 6s6e. All units were dug in 10 cm levels and excavation stopped at either the parent material, or when there was at least 10 cm level that did not produce artifacts. Excavation in the units extended to approximately 100 cm dbs to the parent material, bedrock or a hard packed dark grey medium sand with a large amount of pebbles and cobbles. One of the 1 x 1 m units produced sufficient artifacts (10 or more) to require further expansion. One additional 1x1 m unit was excavated, which did not produce sufficient artifacts to warrant further expansion. The expansion of this area merged with the area around 5s0e so there was an open excavation area of 10 x 5 m containing 39 units.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit, 0s5e. All units were dug in 10 cm levels and excavation stopped at either the parent material, or when there was at least one 10 cm level that did not produce artifacts. Excavation in the units extended to approximately 120 cm dbs to the parent material, a hard packed dark grey medium sand with a large amount of pebbles and cobbles. One of the 1x1 m units produced sufficient artifacts (10 or more) to require further expansion. Therefore six additional 1 x 1 m units were excavated. One of these units produce sufficient artifacts for further expansion. Therefore, an additional three units were excavated, none of which produced sufficient artifacts to require additional unit expansion. The expansion of this area merged with the area around 0s10e, thus there was an open excavation area of 8 x 4 m containing 30 units.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit, 0s10e. All units were dug in 10 cm levels and excavation stopped at either the parent material, or when there was at least one 10 cm level that did not produce artifacts. Excavation in the units extended to approximately 120 cm dbs to the parent material, a hard packed dark grey medium sand with a large amount of pebbles and cobbles. One of the 1 x 1 m units produced sufficient artifacts (10 or more) to require further expansion. Therefore three additional 1 x 1 m units were excavated. None of these additional units produced sufficient numbers of artifacts to warrant further expansion.

The artifact distribution shows two areas of lithic concentrations. The profile of the area shows that at some point in the past, up to 40 cm of overburden was deposited on the area. The trees are young compared to the surrounding forest, and there is a thin sod layer that developed, but no Ae horizon present. Between the surface and the buried paleosol, the sediment is mottled. The buried soil occurs approximately 40 cm dbs with an intact light grey Ae horizon. Artifacts recovered above the buried paleosol are from a disturbed context, whereas those recovered beneath the buried paleosol are in-situ.

There are four distinct areas with lithic concentrations. However, given the lack of features, no distinct functional areas were discernible. The area is a general workshop or processing area.

Locale I: Is an area of artifact concentration located along the north side of the EMR in the west end of CaGi-67 (Photographs 13 & 14). It is located approximately 20 m east of Locale "F". Due to the forested nature of the area, they were assigned two separate grids. The area initially consisted of one 1 x 1 m unit, (10s5e) from the stage 3 site assessment that produced more than 10 artifacts from the soil and first 5 cm of the subsoil.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit, 10s5e. All units were dug in 10 cm levels and excavation stopped at either the parent material, or when there was at least one 10 cm level that did not produce artifacts. Excavation in the units extended to approximately 70 cm dbs to the parent material, a hard packed dark grey medium sand with a large amount of pebbles and cobbles. Two of the 1 x 1 m units (9s27w, 10s28w) produced sufficient artifacts (10 or more) to require further expansion. An additional six 1 x 1m units were excavated; however, none of the additional units produced sufficient artifacts to require further expansion. A total of 15 1 x 1 m units were excavated within a 4 x 4 m area.

The artifact distribution shows one area of low density lithic concentration. Given the lack of features and the low density distribution pattern, no distinct functional areas were discernible. The station is a general purpose lithic workshop/processing area.

Station X is an area of artifact concentration located along the southern edge of the PDA in the centre of site CaGi-67, west of unnamed road. It initially consisted of two 1 x 1 m units (7s6w and 15s8e) from the stage 3 site assessment that produced more than 10 artifacts within the soil and first 5 cm of the subsoil.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit, 15s8e (Photographs 15 & 16). All contiguous units were dug in 10 cm levels and excavation stopped at either the parent material or when there was at least one 10 cm level that did not produce any artifacts. Excavation in the units extended to approximately 40 cm dbs where bedrock was encountered.

None of the eight 1 x 1 m units produced sufficient artifacts (10 or more) to require further expansion.

Eight contiguous 1 x 1 m units were excavated around the stage 3 unit, 7s6w (Photographs 17 & 18). All contiguous units were dug in 10 cm levels and excavation stopped at either the parent material or when there was at least one 10 cm level that did not produce artifacts. Excavation in the units extended to approximately 80 cm to parent material. One of the units (6s7w) produced more than 10 artifacts which triggered the excavation of five additional units. Of those five units, two produced more than 10 artifacts, which triggered the excavation of five more units. Expansion of units continued until a total of 37 units were excavated with artifact concentration numbers ranging between 0 and 140 artifacts. A total of 37 units were excavated within a 6 x 7 m area

The artifact distribution shows a concentration of lithic artifacts in the centre of the excavation with decreasing numbers along the edge of the excavation. Given the lack of features and the distribution pattern, no distinct functional areas were present. The the lithic concentration indicates that this area is most likely a lithic workshop.

5.3.4. Artifact Identification Methodology

Because many of the samples unearthed during excavation were thickly coated with fine soil particles it was difficult in the field to identify minimally modified artifacts that are characteristic of the *Gulf of Maine Archaic Tradition*. Instead, from each unit, the crew collected all rocks that appeared to be "freshly broken" or had sharp edges that could in theory have been useful for working organic materials or were unique in size, and shape. The samples were washed in the field and brushed as clean as possible so the artifact analyst, Ken Swayze, could examine them carefully with a hand lens. Any piece that exhibited modification (retouch scars, notches, flake scars, bipolar cores) or use-wear (invasive step-flake scars, grooves, cone scars) as well as a small sample of debitage (flakes, split pebbles, shatter) were retained for future examination under a microscope. These signs of percussion (Appendix A, Figures 1 & 2) derive from the cone principle of breakage, as described and illustrated in Appendix A. Faint flake scars and other signs of percussion can be recognized by touch as well as sight. Lithic like granite and gneiss contain biotite (mica) particles, in addition to quartz and feldspar, which erode and weather the artifacts, so that flakes scars are not always as distinct as they were when first made and the edges of flakes, which were once acute, become rounded. As a result of these processes, the debitage category of this collection is under-represented, because the analyst selects modified specimens, which are demonstrably artifacts.

The number of rocks washed and the number rejects was not tracked; but, in general, because many crew are seasoned field and laboratory assistants familiar with expedient lithic technology, rock identification, and the surficial geology of the study area, they collected more artifacts than rejects. In general, the more field and lab experience the excavator has, the higher the ratio of artifacts to rejects. Conversely, those with little or no experience with this technology and raw material will have a greater ratio of rejects to artifacts. Paradoxically, even the "high-graded artifact sample documented here appears under-whelming at first glance; particularly since the hallmarks of cultural percussion are difficult to capture in two dimensional photographs. In order to address this artifact invisibility problem, the consultant has included a variety of graphics in Appendix A.

Schnurrenberger and Bryan (1985) have discussed geological forces that may produce natural fractures that might be mistaken for cultural artifacts. Natural fractures are factors of the energy available (high or low) at a specific location and manner of force application. These include: 1) high energy, static loading (such as thick overlying beds and glacial transport); 2) high energy, dynamic loading (such as mudflows); 3) low energy, static loading (such as cryoturbation and solifluction; 4) low energy, dynamic loading (such as a point-bar deposit in a fluvial environment). The only category that could possibly apply to the PDA study area is the last category: low energy, dynamic loading. This kind of energy might be released by a tree-fall, or from grounded ice; however, it is important to realize that the relict strands of the study area vicinity occur on the lee shore of the fossil island, where the ice would not likely have been driven by forceful wind or current. Tree-falls may release sufficient energy to break some stones but the action—prevalent as it is—occurs randomly, where parent materials are deep enough; whereas the archaeological material is clearly associated with relict strands. Although low energy dynamic forces might break some rocks sometimes, it is difficult to identify the natural process in this kind of terrain that could account for the high density of fractured rock. As others have noted, hunter-gatherers select rocks and cobbles because they are resistant to breakage and it takes a great deal of focused energy (percussion) to break these rocks. Moreover, the artifacts demonstrate multiple blows and invasive flaking, which is difficult to explain by natural means.

Because some readers will be unfamiliar with the minimally modified toolkit associated with *Gulf of Maine Archaic Tradition*, like the NSDF sites, the consultant has provided an Archaeological Discussion (Appendix A) below to provide information about this assemblage.

5.4. Catalogue Inventory of documentary record

A catalog of each site has been prepared. A copy will be submitted to MTCS with the final reports (Appendix B) and a copy will be kept with the artifacts.

Notes, photographs, maps and GPS readings were recorded in the field. Hard copies of the notes (175 pages), and digital copies of the notes, photographs (340), maps (31) and GPS readings are on file at Kinickinick Heritage Consulting and Cameron Heritage Consulting Inc.

6. Analysis and Conclusions[11]

The pre-contact artifacts recovered from the stage 1, 2, 3, and 4 archaeological assessments of NSDF indicates that the sites CaGi-65, CaGi-66 and CaGi-67 represents small aboriginal campsites or workshops that occur along the relict shores of a fossil island that existed in the Champlain Sea. No temporally diagnostic artifacts were recovered, and a time period for the sites cannot be determined through artifact analysis. However, geochronological analysis indicates that the earliest postglacial relict shoreline dates between 10,500 to 10,000 BP. Over this period the Early Champlain Sea level fell from over 200 masl and paused briefly at 195 masl, before it reached a centuries long stasis at 180 masl. CaGi-66 is associated with the postglacial relict shoreline with a geochronological date of 9,600 BP, and CaGi-67 is associated with the postglacial relict shoreline with a geochonological date of 8,500 BP (Catto *et al* 1982 and 1983).

The large number of expedient tools suggests that the occupants produced and used tools in a workshop setting. No features were noted at the sites. Although these assemblages appear to compare poorly with more conventional Late Palaeo-Indian and Early Archaic assemblages, which consist of formal types and exotic materials, it must be remembered that even expedient tools have attributes with measurable variation that needs to be studied (see Sanger 1996). Furthermore, they may have evidence of use wear, or surface residue, that can only be detected under magnification. In addition, the lithic scatters could lead to the discovery of pits, hearths, dwellings, and living floors that could provide a wealth of microscopic data for analysis.

7. Recommendations[12]

CaGi-65 I, J, and Q

As per Section 7.11.4 Standard 1 MTCS Standards and Guidelines there is no further cultural heritage value or interest. CaGi-65 has been fully excavated and documented to the extent

11 Section 7.11.3 MTCS Standards and Guidelines for Consultant Archaeologists

12 Section 7.11.4 Standard 1 MTCS Standards and Guidelines for Consultant Archaeologists

required under the MTCS Standards and Guidelines. Therefore no further archaeological work is recommended.

CaGi-66 A

As per Section 7.11.4 Standard 1 MTCS Standards and Guidelines there is no further cultural heritage value or interest. CaGi-66 has been fully excavated and documented to the extent required under the MTCS Standards and Guidelines. Therefore no further archaeological work is recommended.

CaGi-67 F, I, and X

As per Section 7.11.4 Standard 1 MTCS Standards and Guidelines there is no further cultural heritage value or interest. CaGi-67 has been fully excavated and documented to the extent required under the MTCS Standards and Guidelines. Therefore no further archaeological work is recommended.

8. Advice on Compliance with Legislation

This report is submitted to the Minister of Tourism and Culture as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 1990, c. O.18. The report is reviewed to ensure that it complies with the Standards and Guidelines for Consultant Archaeologists (2011) that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection, and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism, Culture and Sport, a letter will be issued by the Ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

It is an offence under Sections 48 and 69 of the Ontario Heritage Act for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the Ontario Heritage Act.

Should previously undocumented archaeological resources be discovered, they may be a new archaeological site, and therefore subject to Section 48(1) of the Ontario Heritage Act. The proponent or person discovering the archaeological resources must cease alteration of the site immediately, and engage a licensed consultant archeologist to carry out archaeological fieldwork, in compliance with Section 48(1) of the Ontario Heritage Act.

The Cemeteries Act, R.S.O. 1990 c.C.4 and the Funeral, Burial and Cremation Services Act 2002, S.O. 2002, c.33 (when proclaimed in force) required that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

9. REPORT CONDITIONS AND LIMITATIONS

This report has been prepared by Courtney Cameron of Cameron Heritage Consulting as a requirement of Archaeological PIFs #P371-0009-2017, #P371-0015-2017, and #P371-0016-2017, and Ken Swayze of Kinickinick Heritage Consulting for the sole benefit of Canadian Nuclear Laboratories, and may not be used by any other person or entity, other than for its intended purposes, without the express written consent of Cameron Heritage Consulting, Kinickinick Heritage Consulting, and Canadian Nuclear Laboratories. Any use which a third party makes of this report is the responsibility of such third party.

The information and recommendations contained in this report are based upon work undertaken in accordance with generally accepted scientific practices, and Standards & Guidelines for Consulting Archaeologists in Ontario current at the time the work was performed. Further, the information and recommendations contained in this report are in accordance with our understanding of the Project as it was presented at the time of our report. The information provided in this report was compiled from existing documents, design information provided by Canadian Nuclear Laboratories, data provided by regulatory agencies and others, as well as fieldwork carried out in 2017 specifically in support of this report. If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, Cameron Heritage Consulting and Kinickinick Heritage Consulting request that we be notified immediately, and permitted to reassess the conclusions provided herein. Any follow-up work recommended in this report must be reviewed by the Archaeology Program Unit, Programs and Services Branch, Ministry of Tourism, Culture and Sport, Province of Ontario, which may take several months after the submission of the report.

We trust this report provides sufficient information for your present purposes. If you have any questions or comments on the contents of this report, or we can be of further service to you, please contact the undersigned.

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CAMERON HERITAGE CONSULTING

Ken Swayze, M.A., P039
Archaeologist

Courtney Cameron, M.A., P371
Archaeologist,

10. References

Cameron, C

2017 PIF P371-0005-2016 *Stage 1 & 2 Archaeological Assessment, Proposed Near Surface Disposal Facility - EMR Site - Lots 20, 21, and 22, Concession Range A and B, Buchanan Township, Renfrew County*, report on file with OMTCS, Toronto.

2018a PIF 371-0008-2017 *Stage 1 & 2 Archaeological Assessment, Proposed Near Surface Disposal Facility - EMR Site - Additional Areas. Lots 20, 22, and 23, Concession Range B, Buchanan Township, Renfrew County*, report on file with OMTCS, Toronto..

2018b PIFs P371-0010-2017, P371-0011-2017, P371-0012-2017 *Stage 3 Archaeological Assessment, Proposed Near Surface Disposal Facility - EMR Site - Additional Areas Lots 20, 22 and 23, Concession Range B, Buchanan Township, Renfrew County*, report on file with OMTCS, Toronto.

Catto, N.R., Patterson, R.J., and W.A. Gorman

1982 The Late Quaternary geology of the Chalk River region, Ontario and Quebec *Canadian Journal of Earth Science* v.19:1218-1231, NRC Ottawa.

Catto, N.R., Gormad W.A., and R.J. Patterson

1983 Quaternary Sedimentology and Stratigraphy of the Chalk River Region, Ontario and Quebec. In. Proceedings of a Workshop on Geophysical and Related Geoscientific Research at Chalk River, Ontario. Ottawa Ontarios. December 14-14, 1983. Ed. Tomas M.D., and D.F. Dixon

CNL (Canadian Nuclear Laboratories)

2016 Near Surface Disposal Facility. Website http://www.cnl.ca/en/home/environmental-stewardship/nsdf/default.aspx

Government of Canada

2012 The Canadian Environmental Assessment Act. Retrieved from http://laws-lois.justice.gc.ca/eng/acts/C-15.21/index.html

Government of Canada

2016 *Reference Guide of Physical and Cultural Heritage Resources*. Website https://www.canada.ca/en/environmental-assessment-agency/services/policy-guidance/reference-guide-physical-cultural-heritage-resources-2-canadian-environmental-assessment-act-cultural-heritage-resources.html Last Updated 2016-07-06. Accessed Jan uary 10, 2017.

Kennedy , Clyde C

1970 The Upper Ottawa Valley. Renfrew County Council: Pembroke

MTCS (Ministry of Tourism, Culture and Sport)
2011 *Standards and Guidelines for Consultant Archaeologists*. Toronto: Ministry of Tourism, Culture and Sport.

Sanger, D
1996 Gilman Falls Site: Implications for the Early and Middle Archaic of the Maritime Peninsula *Canadian Journal of Archaeology* vol. 20:7-28.

Schnurrenberger, D. and Alan L. Bryan
1985 A Contribution to the Study of the Naturefact/Artifact Controversy *In*, Mark G. Plew, James C. Woods, and Max G. Pavesic (eds.) Stone Tool Analysis: essays in Honor of Don E. Crabtree University of New Mexico Press, Albuquerque.

Swayze, Ken
2008 PIF P039-115-2007 *Archaeological Assessments at Chalk River Laboratories, Buchanan Township (Geo.), Renfrew County*. *Inventory of Known Cultural Resources, Cultural Resource Management Projects, Archaeological Predictive Model, and Master Plan,* report on file with OMCTS, Toronto.

Swayze, Ken
2013 PIF P039-180-2012 *Cultural Resource Management at Chalk River Laboratories, Buchanan Township (Geo.), Renfrew County, 2012, Storm Sewer Stage 2,* report on file with OMCTS, Toronto.

Swayze, Ken
2014 PIF P039-210-2013 *Cultural Resource Management at Canadian River Laboratories, 2013-2014, Domestic Water Line Stage 3 Archaeological Assessments on the Original Proposed Alignment & Alternative 2 Routes, Part Lots 24 & 25 Range B Buchanan Township (Geo.), Renfrew County,* report on file with OMCTS, Toronto.

Swayze, Ken
2017a PIF P039-0228-2016, P039-0229-2016, and P039-0230-2016 *Stage 3 Archaeological Assessments of CaGi-65 CaGi-66, CaGi-67, East Mattawa Road - Near Surface Disposal Facility. Part of Lots 20-23 Ranges A & B Buchanan Township (Geo.), Renfrew County,* report on file with OMTCS, Toronto

2017b P039-0232-2016 *Stage 1 &2 AA Emergency Road 3 (ER3) & Dump Road. Pat of Lots 19-21 Ranges A&B Buchanan Township (Geo.), Renfrew County,* report on file with OMTCS, Toronto.

10.1.Personal Communication

Titterington, Susan. Environmental Analyst, Environmental Protection, Canadian Nuclear Laboratories. October 2016

Pucciarelli Ayllon, Diego. Hydrogeologist, Environmental Monitoring Branch, Canadian Nuclear Laboratories December 2018

11. PHOTOGRAPHS

Photograph 1: Excavation at CaGi-65 Station I around 9s24w

Photograph 2: Excavation at CaGi-65 Station I around 9s24w

Photograph 3: Excavation at CaGi-65 Station I around 7s14w

Photograph 4: Excavation at CaGi-65 Station I around 7s14w

Photograph 5: Excavation at CaGi-65 Locale J

Photograph 6: Excavation at CaGi-65 Locale J

Photograph 7: Excavation at CaGi-65 Station Q

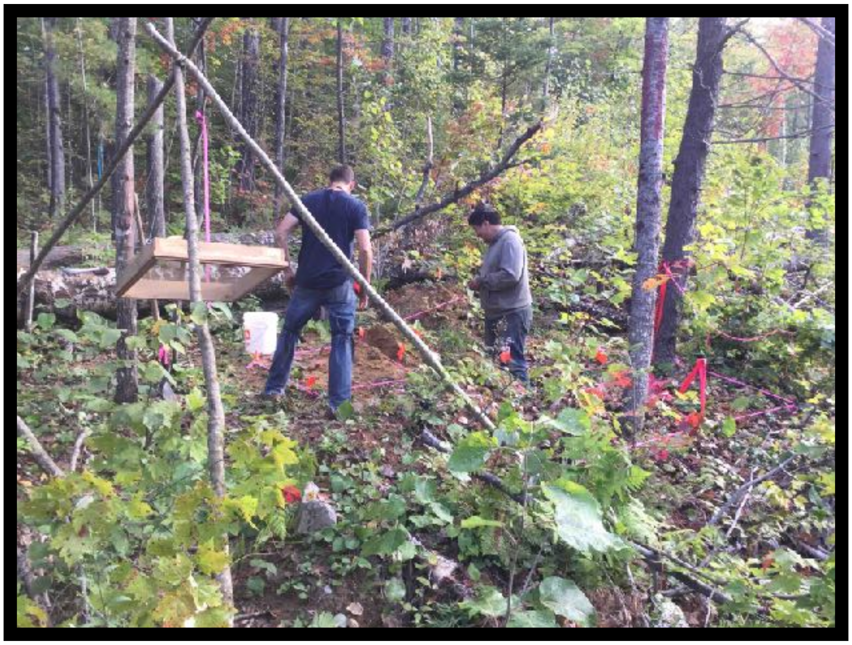
Photograph 8: Excavation at CaGi-65 Station Q

Photograph 9: Excavation at CaGi-66 Station A

Photograph 10: Excavation at CaGi-66 Station A

Photograph 11: Excavation at CaGi-67 Locale F

Photograph 12: Excavation at CaGi-67 Locale F



Photograph 13: Excavation at CaGi-67 Locale I

Photograph 14: Excavation at CaGi-67 Locale I

Photograph 15: Excavation at CaGi-67 Station X around Unit 15s8e

Photograph 16: Excavation at CaGi-67 Station X around Unit 15s8e

Photograph 17: Excavation at CaGi-67 Station X around Unit 7s6w

Photograph 18: Excavation at CaGi-67 Station X around Unit 7s6w

Photograph 19: Excavation at CaGi-67 Locale F showing unit protection from the elements

Photograph 20: Excavation at CaGi-67 Locale F showing unit protection from the elements

FIGURES (MAPS AND PLATES)

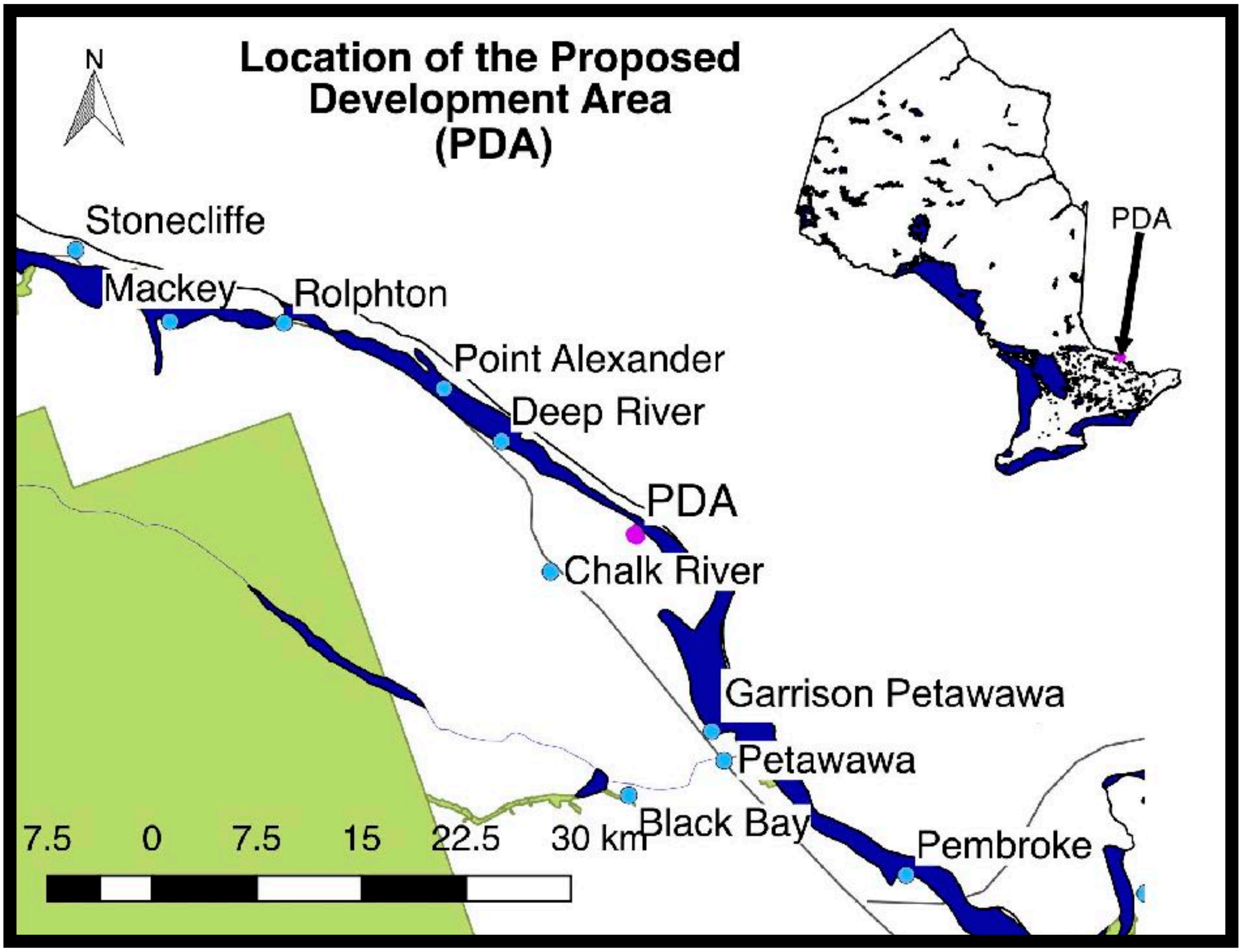


Figure 1. Location of the Proposed Development Area (PDA) in Ontario.

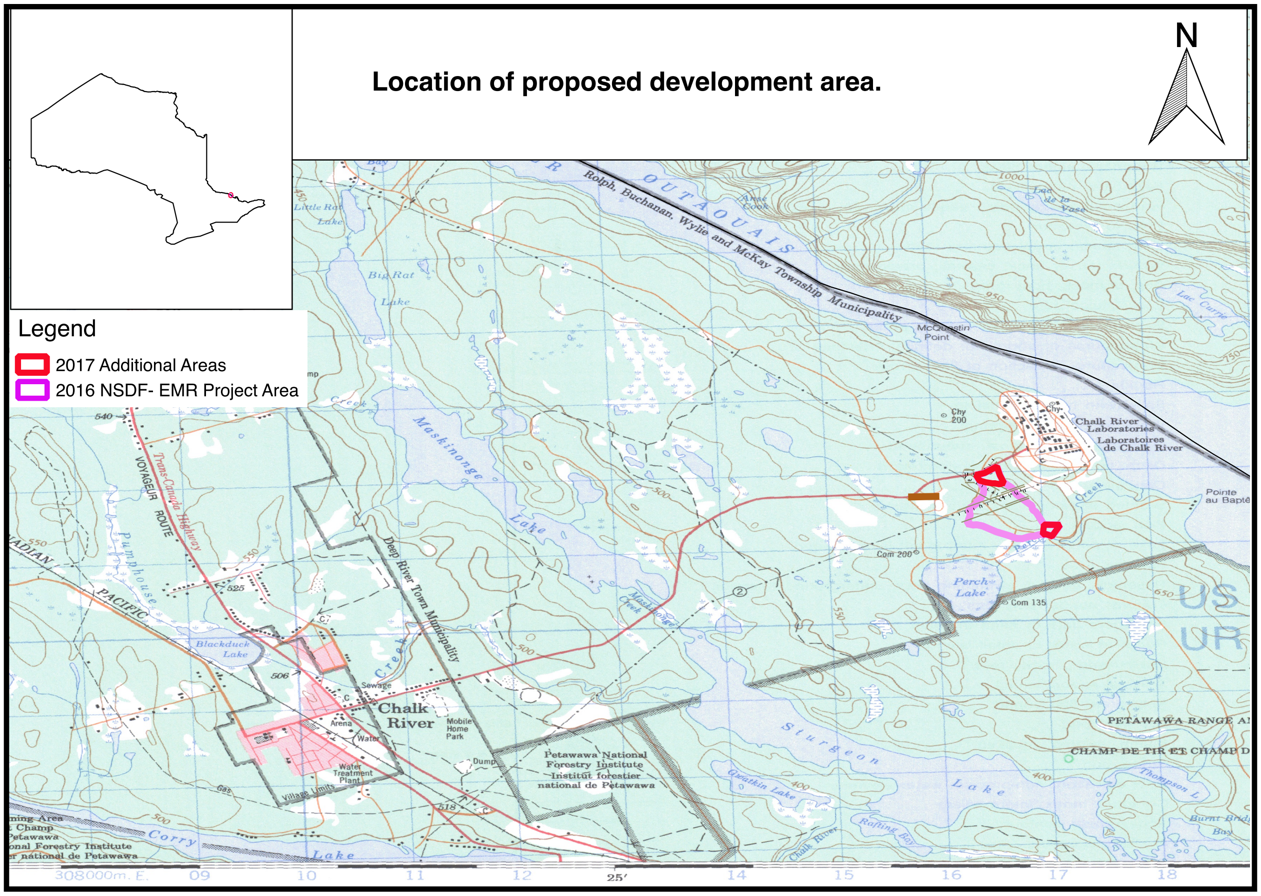


Figure 2. Location of the Proposed Development Area (31K/03 NTS 1:50,000 map)

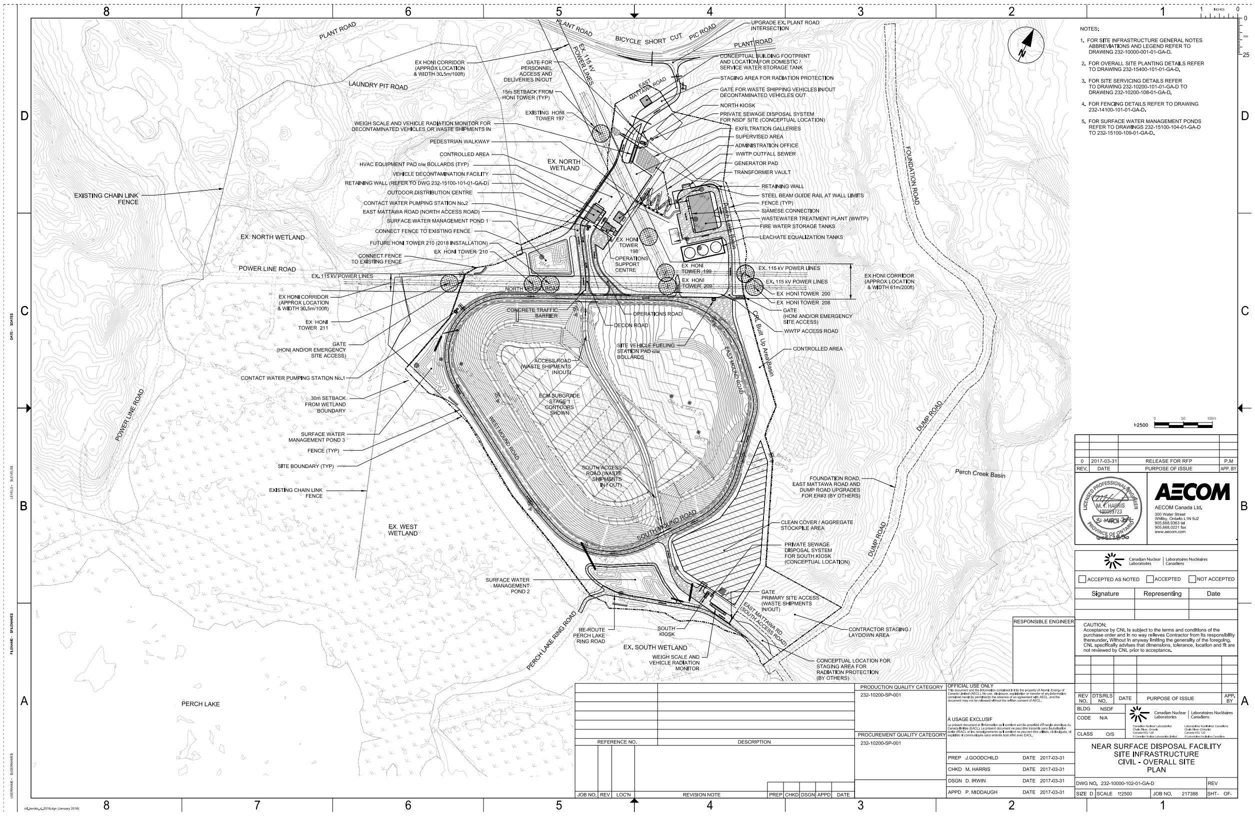


Figure 3: Development drawing of NSDF - Site EMR. Provided by CNL

Figure 4: Map showing the areas of concentration that were subjected to stage 4 mitigation within the NSDF.
Due to the locational data available on the map it is filed separately in Appendix B

Figure 5: Site map of CaGi-65 Station I
Due to the locational data available on the map it is filed separately in Appendix B

Figure 6: Site map of CaGi-65 Locale J
Due to the locational data available on the map it is filed separately in Appendix B

Figure 7: Site map of CaGi-65 Station Q
Due to the locational data available on the map it is filed separately in Appendix B

Figure 8: Profile of CaGi-65 Station I
Due to the locational data available on the map it is filed separately in Appendix B

Figure 9: Profile of CaGi-65 Locale J
Due to the locational data available on the map it is filed separately in Appendix B

Figure 10: Profile of CaGi-65 Station Q
Due to the locational data available on the map it is filed separately in Appendix B

Figure 11: Site map of CaGi-66 Locale A
Due to the locational data available on the map it is filed separately in Appendix B.

Figure 12: Profile of CaGi-66 Locale A
Due to the locational data available on the map it is filed separately in Appendix B.

Figure 13: Grid map of CaGi-67 Locale F
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Figure 14: Grid map of CaGi-67 Locale I
Due to the locational data available on the map it is filed separately in Appendix B

Figure 15: Grid map of CaGi-67 Station X
Due to the locational data available on the map it is filed separately in Appendix B

Figure 16: Profile from CaGi-67 Locale F
Due to the locational data available on the map it is filed separately in Appendix B

Figure :17 Profile from CaGi-67 Locale I
Due to the locational data available on the map it is filed separately in Appendix B

Figure 18: Profile from CaGi-67 Station X

Due to the locational data available on the map it is filed separately in Appendix B

APPENDIX A - ARCHAEOLOGICAL DISCUSSION ON ARCHAEOLOGICAL VISIBILITY

Readers of this report may not be familiar with the use of granite, gneiss, and quartz for stone tools in Ontario in the Pre-contact Period and may wonder if such raw materials are suitable for tools, given that chert, and other microcrystalline stones, are more commonly reported. Also, readers are probably unfamiliar with bipolar and anvil percussion as lithic reduction techniques. These methods can be used to make stone tools instead of, or in conjunction with, direct percussion and pressure flaking, which are the techniques used in bifacial reduction to shape a formal tool. Formal tools, particularly when found in a stratigraphic depositional context, have been instrumental in establishing the framework of prehistory in Ontario because they are chronologically diagnostic. However, life in the Stone Age was profane and in some respects did not significantly change from the Oldowan to the Neolithic. In fact, all cultures that relied on lithic technology to survive, performed most mundane tasks by means of the simplest tools made from cores and flakes. Even though debitage and waste products from stone reduction dominate the lithic assemblages of most Pre-contact archaeological sites, the emphasis in the published literature (especially in the early postglacial period) has mostly been focused on formal tools and exotic material. A few observant archaeologists, such as J.V. Wright, have remarked upon this bias but the problem was and is rarely addressed.

"The most common tool encountered, as in all stone tool-using cultures, is the stone flake that upon being detached from a core is razor sharp and capable of performing a wide range of cutting, scraping, slotting, and puncturing functions with no or little further modification" (Wright 1999:30).

The discussion below describes and compares different methods of percussion direct, bipolar, and anvil); discusses the suitability of igneous and metamorphic rock for stone tool use; archaeological invisibility and bias in the archaeological record; and the theory of Archaic and Mesolithic stone tool adaptations. The discussion also includes annotated references from peer-reviewed literature that describe anvil and bipolar percussion and the use of non-chert stone to make tools of expediency. The references discussed first are from international contexts (Chile and Sweden), followed by examples from Western Canada, Northeastern United States, and lastly, from Ontario.

1. <u>A Comparison of Percussion Methods</u>

With direct, freehand, percussion and bifacial reduction, the mechanic follows a sequence of flake detachments and attempts to predict how each flake will detach in order to shape the biface into a preconceived form. The ability to shape a biface into a formal projectile point type requires practice and skill and is easier to accomplish when the raw material is a tractable stone like chert. Bipolar percussion, on the other hand, requires no skill or practice and works well with any raw material. While it is impossible with bipolar percussion for the mechanic to predict how the flakes will be detached, the technique is certain to produce a multitude of useful edges and points that can be used to work organic substances with minimal modification-or none at all. While in bipolar percussion the force is delivered straight down into the centre of the core, anvil percussion allows a degree of flake prediction because the blow is directed at an angle to the core towards the outside of the core.

The bipolar technique is simple: place a core-a quartz or quartzite pebble, or cobble, or tabular piece of quartz or chert on a large hard stone (called an anvil) and strike it straight down at the anvil with a hard hammerstone. Typically, the core will exhibit crushed poles and, if battered repeatedly, may become bi-pointed. Bipolar percussion results in a variety of flakes but, typically, negative and positive bulbs of percussion are not readily apparent. After a pebble core is shattered on an anvil, the mechanic selects pieces with appropriate edges to use as tools-of-expediency for the task at hand. These are not curated but are disposed of when the task is complete.

Regardless of the type of the type of percussion used, the Cone Principal of physics governs the process of stone breakage-whether the material has good conchoidal properties or poor (see Figure 32b). The hallmarks of a flake detached by direct percussion include: prepared, or distinct, platforms, a pronounced bulb of percussion (sometimes with an *eraillure* flake scar), and ripple marks and flakes detached in the course of bifacial reduction will include primary and secondary flakes, as well as characteristic types such as “thinning” and “bifacial retouch” flakes. Bipolar and anvil percussion, on the other hand (while capable of producing a flake with "classic" hallmarks) produces a wide variety of flakes, fragments, chunks, and blocks. While anvil percussion includes some degree of "flake prediction" in the detachment of primary and secondary flakes, the result of bipolar percussion, in particular, cannot be predicted. Nevertheless, the mechanic can expect certain useful forms to recur, namely: “citrus wedge” shapes, “triangular flakes”, and “multiple flakes” (see Figure 33b). Citrus-wedge shapes (see Figure 33c) especially result from bipolar percussion of cobbles and pebbles and can be used unmodified as backed knives, or minimally modified for other tasks. Triangular flakes are long and thin with parallel sides and a triangular cross section (see Callahan 1987). Multiple flakes are long wide thin flakes, with no apparent dorsal face, produced as multiples. Multiple flakes are sometimes the largest, thinnest, flake possible from small cores and they make excellent biface preforms (see Boksenbaum 1980). Hallmarks of bipolar percussion cores include: multi-facetted surfaces, with one or more crushed, battered, and pointed poles. Anvil percussion cores may have prepared platforms and many small circular cone scars (sometimes with concentric rings, sometimes overlapping) are common (in addition to the cone scar that initiated the flake detachment) while a battered and pointed, pole may develop at the opposite end. The cores may be used to detach one or two flakes, or many flakes may be detached from multiple faces. Anvil cores will sometimes show negative bulbs of percussion and anvil-struck flakes may have pronounced or diffused bulbs of percussion, depending upon the raw material. Since the source of raw materials such as granite and gneiss are often boulders, rocks, ledges and cliffs, primary and secondary flakes are often very large, they are usually broken up into smaller pieces by means of "compression breaks" - a hallmark of bipolar percussion induced by bipolar percussion, to make useful shapes and edges.

Crabtree (1972; 1973) and Cotterell and Kamminga (1987) describe how flakes can be shaped by compression breaks (induced by bipolar percussion) that produce flake fragments with edges with a straight, right-angled, edge profile, if there is direct contact between the hammerstone and the anvil. If the anvil has a depressed surface the break profiles will be concave/convex. Compression breaks are a common way to split pebbles and cobbles and reduce the size of large flakes and spalls struck from cobbles and boulders. They also serve to make the "back" of an edge used as a knife.

2. <u>Suitability of Igneous and Metamorphic Rock For Stone Tools</u>

Granite and gneiss are of similar chemistry, since both are predominantly made up of grains of quartz and feldspar, with other minerals, such as biotite, in smaller proportion. Chert, quartz, and felspar are all forms of silica and are similarly hard, all at least 6 in Moh's scale of hardness. The biotite grains often found in granite and gneiss are soft in comparison but, overall, a freshly detached flake of granite or gneiss can be very sharp indeed-sufficient, in any case, for short-term expedient uses, such as to: cut, scrape, saw, or perforate organic materials like fish, flesh, skin, bone, ivory, bark, or wood. However, once percussion has taken a flake of granite or gneiss from the lithosphere into the biosphere, the material begins to degrade from the effects of sunlight, chemical weathering, and frost. While a chert flake struck from a biface, for instance, may develop a surface patina; a flake of granite or gneiss will be affected by surface particle attrition caused by the erosion of the softer mineral grains (such as biotite) so that, over time, the flake edges and ridges between flake scars are increasingly rounded and indistinct. Collins (1997:385) notes that, over time, chemical weathering alters the "freshness" or appearance of stone facets, resulting in changes in colouration, surface pitting, and the gradual rounding of working edges and flake scar arrises. This process occurs widely and contributes to the archaeological (in)visibility problem discussed below.

In terms of suitability for bifacial reduction and to shape projectile points, microcrystalline materials like chert are ideal-if a large enough flake can be struck to make the preform-but quartzite and other cryptocrystalline rock can suffice. Even rather coarse-grained igneous and metamorphic rock can be worked into bifaces and points-by skilled and determined mechanics. For the most part however, these materials lend themselves to bipolar and anvil percussion and the manufacture of expedient or informal tools. For such purposes, the "schistocity" and natural cleavage of such materials can be used to advantage in the reduction process. (This too contributes the invisibility of non-chert material.)

3. Archaeological Visibility and Invisibility

Stone tool assemblages made from igneous and metamorphic rock by means of bipolar and anvil percussion have low "archaeological visibility" because archaeologists are, in general, are most familiar with the bifacial reduction of raw materials like chert by means of direct percussion and pressure flaking while unfamiliar with bipolar and anvil percussion. This has skewed artifact collections in favour of chert artifacts with aspects of direct percussion or bifacial reduction; while the other artifacts are ignored or overlooked and become archaeologically invisible. In this way, a site can be "invisible", because all or most of the artifacts are of igneous or metamorphic material worked by bipolar or anvil percussion. These kinds of sites only become visible when diggers have learned not to discriminate against non-chert materials and to look for hallmarks other than those more common to direct percussion. Even then, samples of non-chert stone should be routinely collected during test pit survey and examined in the laboratory after they have been washed.

By way of example, consider a joke that has been common in archaeological social circles for decades: where a neophyte digger shows a stone to a field director and asks "Is this anything?" only to be told it is a "dog-stone", while it is thrown at an imaginary scavenger.

Other factors that have contributed to the archaeological invisibility of minimally modified tools (especially those made from igneous and metamorphic rock by bipolar and anvil percussion) have more to do with surficial geology and demographics. One of the reasons it is difficult to locate early postglacial sites in Eastern North America is that the sea coast and lower river valleys in the early postglacial were submerged over the millennia by rising sea levels. The situation was similar in peninsular Ontario through the Early and Middle Archaic periods, because the water level of the Great Lake basins were well below today's level for millennia. Given that proximity-to-water is the principal assumption of archaeological site prediction models, the highest areas of archaeological potential for Early and Middle Archaic sites in peninsular Ontario is now underwater and unavailable to normal methods of archaeological discovery. Obviously, this situation has biased the archaeological record of this period towards "inland" sites.

The great rift valley of the Nipissing-Mattawa-Ottawa-St Lawrence drainage, however, stand in contrast to peninsular Ontario, for this ancient channel contained huge volumes of water for thousands of years. Because the floor of the rift valley experienced rapid and extreme isostatic rebound, a sequence of relict shorelines formed as the water level gradually receded.

These relict shorelines ring the valley walls from Quebec City to the north shore of Lake Nipissing.

The demography of Ontario has contributed to the invisibility problem because most archaeological research, past and present, has mainly taken place in peninsular Ontario, where most of the population lives and where igneous and metamorphic materials are relatively scarce and crypto-crystalline materials, like chert, are readily available. Eastern and northern Ontario on the other hand, where chert is rare and granite or gneiss are common, has received very little attention.

4. <u>Theory of Lithic Technology in the Archaic</u>

Brian Hayden and William Andrefsky Jr., are two well-known lithic experts who have developed theories of lithic use that are appropriate in the current context.

In a paper published in *Current Anthropology* Brian Hayden (1981) discussed technological adaptation among hunter-gatherers during the transition from Palaeo-Indian to Archaic, in the New World, and from the Palaeolithic to the Mesolithic in the Old World. The Palaeo cultures are characterized by nonpermanent habitation, high mobility over a large land base, and the exploitation of large to medium-sized game animals in areas of high carrying capacity, which led to a wide geographic distribution of technological and stylistic stone artifacts. Archaic and Mesolithic cultures, on the other hand, are "...characterized by two major trends: general diversification of resources exploited in areas of poor-to-moderate resource richness and a tendency toward specialization in habitually exploited resources in resource-rich areas." Diversification resulted in the exploitation of smaller animals and gave new economic importance to plant foods and fishing. The use of a few simple tools became a hallmark of the Mesolithic/Archaic adaptation. Groundstone tools (such as edge-ground wood-cutting tools like axes, adzes, gouges, ground-slate knives) and the use of copper first occur with any regularity in the archaeological record of this period. In particular, Hayden points out the use of local raw materials, often poor in quality, as opposed to very high-grade exotics. This change in technological adaptation in the Archaic was sometimes called "degeneration" when compared with the projectile points characteristic of the Clovis-Folsom-Dalton tradition. According to Hayden, the technological adaptations of the postglacial period were a result of environmental stress brought on by climatic change and landscape evolution.

Hayden notes that current anthropological theory holds that highly mobile hunter-gatherer cultures-like Palaeo-Indians-tend to make use of very high-quality material, often obtained through trade, to make formally shaped tools, like projectile points or endscrapers; while more sedentary groups-such as Archaic cultures-often relied on informal and expedient tools made from poorer quality, locally available raw materials.

William Andrefsky Jr. has developed and tested a theory of lithic organization (*American Antiquity* 1994 v.5 (1):21-34), based on the relative abundance and quality of lithic resources of any given region. He examined three large, widely separated, study areas in western USA, which contract archaeologists had systematically assessed. Each area had very different characteristics in terms of lithic abundance and quality and both mobile hunter-gatherers and sedentary agricultural cultures had occupied each area.

In the first area, where high (chert) and low quality (sandstone, quartzite, limestone, basalt) raw materials were available but not abundant, the expected association between tool design and mobility did not hold, since both formal and informal tools were made by both sedentary and mobile hunter-gatherer cultures. Moreover, even though very high-quality material was available through trade from nearby sources, local lithic materials were used to make over 90% of all tools. The second area did not contain any good quality materials and only a few poor materials (quartzite and schist) were available. The stone artifacts recovered were largely made from high quality materials (chert, obsidian, and quartz crystal) obtained through trade from sources a considerable distance away. This material was used predominantly to make formal tools (projectile points, unifaces, scrapers, perforators, gravers) rather than informal ones. The poor quality coarse-grained material accounted for only 13% of the artifacts-all of them informal. In area third case, relatively poor quality lithic material was available throughout the area and formal tools were made from a variety of high quality lithics obtained through trade; while poor quality local material was used for informal ones. Andrefsky concluded that lithic raw material availability is a significant factor in the organization of lithic technology. His observations are summarized in a four-cell contingency table with lithic abundance (high or low) on one axis and lithic quality (high or low) on the other. According to Andrefsky's model, archaeological lithic assemblages like the ones from the NSDF sites would characterize situations where lithic quality was either: low with low abundance, or low with high abundance. The NSDF technology falls into the latter category.

5. Annotated References from Peer-Reviewed Literature

Below are annotated references from peer-reviewed archaeological literature that address in more detail the questions raised by raw material, suitability, and tool category and provide interested readers with additional references to refer to for study purposes. Although there are no pertinent peer-reviewed publications that refer specifically to Renfrew County archaeological discoveries, there are many examples from international settings and from other regions of North America, including western Canada, Northeastern North America, and Ontario.

5.1. International References

Chile

At the world-renowned Monte Verde site in Chile a peat bog has preserved an example of a Pleistocene culture with excellent cultural deposition. The deposit included traditionally recognized kinds of stone artifacts and others that are less clearly modified or used and do not constitute artifact classes or types in the usual sense. The assemblage includes a few curated tools of formal design and a large number of expedient tools. In the 1980s, the excavator, Tom Dillehay, realized that the assemblage of stone tools from Monte Verde were invisible to many North American archaeologists and needed to be assessed in an objective manner to learn how they were made and their suitability for stone tools.

Michael Collins (1997) addressed this invisibility problem through a descriptive and morphological analysis of formal and informal stone artifacts in volume 2 of "Monte Verde a Late Pleistocene Settlement in Chile" a case study of the *Smithsonian Series in Archaeological Enquiry* that addresses important research problems and demonstrates useful methodological approaches to analysis. To this end, Collins (and Tom Dillehay) carried out use-wear analysis and experiments using replicas of the expedient tools. Their general conclusion was that “expedient use of minimally modified stones was an important aspect of the lithic technology at Monte Verde and that many specimens lacking macromorphological evidence for cultural modification or use were, in fact, probably part of the tool kit.”

In total, 752 stones were analysed with an almost entirely inductive approach due to a lack of a paradigm. In particular he found the Palaeo-Indian model for interpreting chipped stone artifacts applied to less than 5% of the sample. A fundamental aspect of the study was to distinguish human from natural processes that affect stone and he compared the 752 specimens-found in excellent depositional context on the floor of well-preserved dwellings to a representative sample of stones from gravel beds in the surrounding environment. The null hypothesis of his comparison was that the stones recovered from archaeological contexts were a result of natural processes. The form of the cultural example proved to be significantly different from the natural one. Experimental replication indicated that the cultural sample had functional utility and microscopic analysis indicated, through visible use wear and the presence of organic residues, that artifacts in the archaeological sample were used as tools.

Collins, who has a background in Palaeo-Indian lithic analysis, initially saw nothing unquestionably cultural about the stones and, with the exception of one or two specimens, he suspected that most would not prove to be demonstrably cultural. However, after 12 years of study to develop the criteria that could discriminate cultural breakage from natural fracture, he learned “...to view the Monte Verde stones as part of a sophisticated prehistoric culture that efficiently tapped the local geologic environment ...and he had "no longer any doubt that the assemblages ...are cultural and represent effective sophisticated use of available lithic resources. These assemblages simply look clumsy and ineffective.”

The most common raw materials at Monte Verde were igneous rocks like basalt, tonalite, andesite, tuffs, gabbro, and diorite, and metamorphic rocks, such as quartzite, and gneiss. Quartz was another raw material that was selected for use. Some examples of informal or expedient tool categories broadly similar to those at the South Shore Loop site are: notches; choppers; cores; flakes; edge-battered stones; single-faceted split stones with macroscopic evidence for use; single faceted stones without macroscopic evidence of use; multifaceted stone with macroscopic evidence of use; multifaceted stones without macroscopic evidence of use; single-facetted battered stones; faceted stones with one right angle; and hammerstones.

Sweden

Errett Callahan (1987), a Palaeo-Indian lithic specialist from the USA, published the results of an intensive study of the lithie technology called "An Evaluation of the Lithic Technology in Middle Sweden during the Mesolithic and Neolithic", which was funded by the Swedish Council for Research in the Humanities and Social Studies and published in Aun 8 by *Societas Archaeologica Upsaliensis*. The stone tool technology he described, replicated, and tested in such detail is similar to the assemblages found in the DWL sites.

According to Callahan, the problem addressed is “both unique and universal” since, on one hand, “it is totally different from the well-known technology of southern Sweden and Denmark” yet “it is relevant to many cultures throughout the world where coarse materials such as quartz and quartzite predominate and where tool typology is vague”. He notes, too, that part of the problem (which contributes to its archaeological invisibility) is this lithic technology (although recognized by earlier generations of archaeologists) “...has been either ignored or given superficial treatment in the literature until now.”

Bipolar percussion is used to make pebble and cobble tools. It is an elegant method of deriving useful lithic edges from ubiquitous raw materials that are too small to permit bifacial reduction of long flakes or blades struck from cores. Hunter-gatherers globally have used variations of this lithic reduction strategy from the time of our earliest ancestors to the ethno-historic present. It is a deceptively simple technique but part of an essential strategy of the early Holocene pioneers of those parts of Ontario characterized by the Canadian Shield or the rocky till that flanks it.

> "This model allowed virtual freedom of movement across the landscape, with any size and kind of lithic material being suitable for use. The evolution of a system dependent upon rather small flakes of predominantly local material and an informal, fluid, tool typology may have been a master stroke of wisdom..." (Callahan 1987:61)

According to Callahan, many researchers have not recognized "...that bipolar reduction is a process, not just a fracture type ...there is no such thing as a true bipolar fracture ...wherein cracks are simultaneously produced at both poles of the core ...it makes no difference whether one or two cracks are produced. What is important is that the process involves a core being struck straight downward from above, perpendicular to both the core top and the anvil" (ibid. l3).

The assemblages studied in 1984 came from four sites in Middle Sweden, two excavated in the late 1930s, 1977 and 1981 with a total of 63 "drawers" of stone artifacts made from quartz, quartzite, halleflinta, and porphyry. (Callahan notes that the informal and expedient artifacts were largely "invisible" to the excavators, who were unfamiliar with these kinds of artifacts, and so a good deal of non-artifacts and fire-cracked-rocks were included in the assemblage.)

The classification system devised by Callahan includes: cores (freehand platform, anvil platform, and bipolar); chopper-like cores (freehand and anvil); unmodified/unretouched flakes (freehand/anvil, bipolar, triangular splinter); modified/retouched flakes (scraper-like, denticulate-like, spokeshave-like, borer-like, bifacial-like, transverse point, oblique point, retouched flake); core scrapers; microblades; thick pieces/blocks; hammerstones; anvil stones; stone axes; abrading stones.

Callahan carried out over a hundred structured experiments using replicas of the cores and flakes made from same raw lithic materials available locally. The result was an invaluable lithic reference collection stored at Upsala University. In one test, Callahan butchered sheep using flint, quartz, and porphyry separately. He found the quartz be the superior material for this task but, to his surprise the porphyry flake proved to be more than adequate and even coarse quartzite was "suitable enough for certain common tasks".

5.2. <u>Western Canada</u>

The expedient use of pebbles and cobbles as tools by pre-contact cultures is a lithic technology that was first recognized in Canada by Carl Borden (1960) at the Milliken site in the Fraser Valley, British Columbia (published in *Contributions to Anthropology 1957*, National Museum of Canada, Bulletin 162:101-118, Ottawa). His later research (Borden 1975) demonstrated that cobble tools in various forms were a common adaptation of hunter-gatherers in a littoral, riverine, or marine environment. Some prominent researchers see the common, systematic, use of pebble and cobble tools as a technological hallmark of early cultures in the Northwest Coast (Carlson 1979; Fladmark 1990). Others have observed that in more recent contexts (such as shell midden deposits in the Lower Mainland of the Fraser Valley) pebble tools continued to be used for special purposes (Grabert 1979).

5.3. Northeastern North America

Robinson (1992: 95-97) defined a Gulf of Maine Archaic Tradition as a technological pattern (not a substitute for a whole cultural tradition) spanning the Early and Middle Archaic periods in northern New England, between approximately 9,500 and 6,000 BP. Like the NSDF assemblage, it is characterized by "a flaked stone industry dominated by core, uniface and flake technology;" together with low frequencies of bifaces and a paucity or absence of projectile points, and ground stone tools. Ground stone artifacts are represented at frequencies of between 0 and 11% of the lithic tool assemblages at several early Archaic sites (Robinson 1992:102).

Victoria Bunker (2002: 25) states in *The Indian Heritage of New Hampshire and Northern New England*: "A nonbifacial toolkit has recently been recognized throughout northern New England during the Early Archaic period. Quartz is the primary stone tool material in this tool kit, which consists of a variety of steep and beaked unifacial edge tools, cores and flakes." Dincauze (1993:12) reports Early Archaic assemblages from central and northern New England sites that consist almost entirely of quartz uniface tools. Bourque (2001: 41) notes that the Early Archaic occupants of Maine flaked occasional tools from chert and rhyolite, but that "They also made many scrapers and minimally modified unifacial tools from quartz. In fact, an abundance of quartz flaking debris is one of the hallmarks of Early Archaic sites."

Quartz is a primary raw material for flaked stone tools in the Gulf of Maine Archaic tradition technological pattern, although a variety of igneous and metamorphic rocks are commonly used when quartz is not present, as is the case at the NSDF sites. Robinson (1992:96) characterizes these artifacts as "steep-edged quartz unifaces, irregular cores, flake tools, blocky fragments and flakes." Sanger (2005: 19) describes the Early Archaic from Maine as characterized by a variety of crude tools made from quartz and metamorphic rock, with forms that are "more functional than elegant." Robinson (1992:97) notes that thick-bitted uniface "scraper" intergrades continuously with cores.

David Sanger published an article in 1996 in the *Canadian Journal of Archaeology* (v. 20:7-28) in which he noted that prior to 1980 interpretation of the archaeological record in New England from the early and mid-Holocene period "depended almost entirely on extension of culture types defined outside the region"; however, since then, considerable new data about the Early and Middle Archaic in Maine has appeared that demonstrated the inadequacy of the imported models.

At the Gilman Falls site on the Stillwater River in Maine, Sanger excavated a Middle Archaic quarry and workshop site, where poor quality, metamorphic rock (phyllite and granofels) had been reduced by bipolar/anvil percussion and used to fashion both formal and informal/ expedient tools. Some of the phyllite choppers he illustrates resemble artifacts from the South Shore Loop site. In reference to such tools, he notes:

> "Tempting though it may be to dump all of these unprepossessing tools into the catch-all category "expediency tools", closer examination reveals variability, some of which may be significant... Despite the tendancy to over-differentiate, a substantial number of pieces is relegated to "flaked phyllite", defined as artifacts that exhibit minimal shaping. *If found in later contexts, many specimens in this class might well be discarded as non-artifactual.*" (Sanger 1996:14; Note: emphasis added to highlight archaeological visibility).

The stone artifact categories at Gilman Falls include: groundstone rods, rod preforms gouges, and celts; choppers; phyllite "slate" points; battered nodules. Choppers are "large heavy, crudely-worked pieces affecting a steep edge angle, often unifacial, sometimes bifacial". "Battered nodules" is a term Sanger applies to "flaked felsite cobbles" with battered ridges between flake scars. Sanger speculates that the rods may have been used to sharpen the gouges. Sanger notes that "Gilman Falls joins with other central Maine sites in the apparent paucity, or even absence, of a chipped projectile point tradition during part of the Middle Archaic" and he suggests that the projectile points may have been made from organic substances. Sanger notes that the material (quartz-muscovite granofels and/or phyllite) is difficult to flake bifacially, "however, this rock can be shaped by unifacially flaking along one edge. The blank is then turned over and reduced unifacially along the second long edge, a technique which produces a beveled cross section." (Ibid:l9).

The retouched and notched tools in the NSDF assemblages resemble the steep-bitted "scrapers" and "edge tools" reported from the lower levels of the Eddy site in Manchester NH, dated to approximately 8000-7500 BP (Bunker 1992:141). The range of artifacts in the NSDF sample is similar to those of the quartz and rhyolite assemblages from the Early Archaic levels of the Brigham and Sharrow sites in the Maine interior, dated to between about 9500 and 7500 BP (Petersen and Putnam 1992: 32, 34).

In 2006 Adrian Burke, a lithic source specialist from McGill University, described his work (a collaboration with Brian Robinson, University of Maine) on Palaeo-Indian period lithic sources in the New England States and Quebec in a paper titled "PaleoIndian Ranges in Northeastern North America Based on Lithic Raw Materials Sourcing", In: *Notions de territoire et de mobilitee. Exemple de l'europe et des premieres nations en Amerique du Nord avant le contact European.* ERAUL 116 (*Actes de sessions presentees au Xe congress annuel de l'Association Europeean des Archaeologues (EAA)*, Lyons, 8-11 septembre 2004, edited by C. Bressy, A Burke, P. Chalard, H. Martin (dir.)., pp. 79 a 89, 2006. Études et Recherches Archéologiques de l'Université de Liège, Liège.

Burke questions the theory of Palaeo-Indians in New England and Quebec—an area of Pre-Cambrian Rock—as "tethered" to exotic "tool stone" only available hundreds of kilometres distant. He notes that "Palaeo-Indians seem to be the exception to the rule in terms of typical fall off or distance decay models used in archaeology" by practitioners such as Colin Renfrew. Burke attributes this seemingly expensive strategy to their pioneer status and being unfamiliar with local resources. (Note: Burke's work and his references are biased, since they were based on work carried out when the "Clovis First" theory of the first peopling of North America held sway. Today, most students of the Late Pleistocene would acknowledge the probable and likely presence of peri-glacially adapted hunter-gatherers for thousands of years before Clovis.) Although Burke agrees Palaeo-Indians focused on "high quality" cryptocrystalline stone (like Munsungun chert, the focus of his paper) he notes they also "privileged" massive bedrock sources, such as rhyolite, crystal quartz, and quartzite, in addition to "…local, coarse grained igneous rocks [that] were used systemically for "larger tools with a few flake removals, (eg., scrapers, planes, choppers, core tools." (p. 4). He points out that igneous rocks were used for larger tools at Bull Brook and other Palaeo-Indian sites in New England, like Michaud, where local diabase was worked. Burke observed that while much discussion has revolved around the long distance movement of high quality, distinctive raw materials during the Paleoindian period, less attention has been paid to the use of lesser quality raw materials (Burke *et al* 2014). Just because there hasn't been a lot of research in this area, does not mean that this area of research is invalid. In fact, more research in this area is warranted.

5.4. Ontario

In 1939, Kenneth Kidd (then Curator of Ontario Archaeology at the ROM, later a professor at Trent University) and Norman Emerson (then a student, later a professor at the U. of T.) carried out one of the first professional excavations on a pre-contact site in northern Ontario at Rock Lake in Algonquin Park. In 1948, Kidd published an account of this excavation in the *Southwestern Journal of Anthropology* (Vo1.4:98-106). "Two superimposed cultures of simple content" were revealed in an excavation of 375 square feet, which contained about

1,000 bone fragments, 392 Late Woodland potsherds, and 253 stone artifacts (excluding fire-cracked rock), including 64 pieces of exotic chert. The exotic chert was used to make formally shaped scrapers, while “The slate culture, from the lower portions...” may have been older, possibly from the Archaic period. Most of the artifacts, however, were of quartz and slate and included numerous granite pebbles and other stones. Kidd notes that: “By far the greater number of these showed no evidence of human workmanship” (ibid:101). One of the formal artifacts recovered was a crude edge-ground axe made from "finely consolidated granite" (like felsite). Kidd classified a large proportion of the slate stone artifacts as “problematical tools” that he defined as: “...extremely crudely made, so crudely that their purpose can only be guessed at. There are four pieces which may conceivably have been used as scrapers...” (ibid:102). One of the artifacts Kidd illustrates in the report (Ibid:Fig 1c) is an irregularly-shaped, step-flaked, slate piece that he calls a scraper-it is similar to artifacts from the NSDF sites. Such artifacts might more accurately be termed simply “retouched flakes”. Kidd was a prescient archaeologist who understood that some artifacts were “archaeologically invisible” (he did not use that term however), so obviously many stone artifacts in his collection-like those from Monte Verde or Middle Sweden-were collected because of their depositional context and association with demonstrable artifacts: “Many of the other twenty slate pieces have edges which could have rendered them useful as scrapers, show no conclusive evidence of having been so employed.” (Ibid:103). Kidd did not doubt that the problematic pieces were artifacts, he only wondered if they could be described by conventional functional terms.

In “Some Distinctive Palaeo-Indian Tool Types from the Lower Great Lakes” Chris Ellis and Brian Deller (1988 *Midcontinental Journal ofArchaeology* Vol. 13(2):111-158) describe seven chert artifact types from Palaeo-Indian sites in Ontario. Although focused on that period, the discussion is relevant to the early postglacial period and Archaic cultures as well. The function of the stone artifact types described in the article is defined by form, not by use wear. The seven types are: large alternately beveled bifaces; “backed” bifaces; proximal end and side scrapers; asymmetrical end scrapers; narrow end scrapers; hafted perforators; backed and snapped unifaces. With 25 years hind sight, Swayze considers that the site sample employed would fall with cell 1 of the quality/abundance contingency table presented by Andrefsky (1994 see above), where the sites are in a region with abundant high quality raw material and so both formal and informal artifacts are made from high grade material obtained locally or from nearby sources. In fact, some of the techniques described here with high-grade material are the only effective methods of working poor quality material, which is ubiquitous in northern and eastern Ontario. These techniques are: "alternate edge beveling" and "backed and snapped" artifacts.

The alternate edge beveling technique was described, replicated, and tested by Callahan (1987-see above), who notes that it is the best way to shape poor quality coarse-grained material. Backed flakes, whether they are retouched or not, were commonly used tools in the Stone Age. The "back" is a wide, blunt, side of the flake opposed to a sharp, acute, edge, so the mechanic can apply force without injury to the hand. The back can be natural or cortex edge (as in case of "citrus-wedge" shaped cobble fragments), or an edge made blunt by steep retouch; or by a compression break, called "snapped" by Ellis and Deller (1988). (The consultant follows the terminology used by Crabtree 1972, 1973 and Cotterel and Kaminga 1987.) Ellis and Deller (1988:119-120) describe backed and snapped tools as: "very distinctive..rectangular in plan ...and roughly wedge-shaped in transverse section". One of the working edges of such pieces is the thin lateral edge opposite the thick back has a unifacially sharpened edge and an acute angle of 40-75 degrees. "Another distinctive aspect of these tools is the presence of a bend or snap break at one or both ends of the tool ... [and]...the retouch is superimposed over the snaps." This technique works well with poor quality material. Compression-broken edges with steep shallow unifacial retouch are found on Gulf of Maine Archaic tradition sites in New England (Bunker 1992).

In "An Early Palaeoindian Cache of Informal Tools at the Udora Site, Ontario" (*Research in Economic Anthropology: a Research Annual*, Supplement 5, pp 45-93) Peter Storck and John Tomenchuk (1990) describe a sample of informal and expedient tools from a Palaeo-Indian site associated with the relict shoreline of Glacial Lake Algonquin. The material was found in several discreet cultural features and although no unquestionably diagnostic Palaeo-Indian artifacts were found in the features there were several "backed and snapped" artifacts found. The material is high quality Fossil Hill and Onandaga chert that would have been available through trade or by journey to the source. Storck and Tomenchuk classified the 78 informal tools according to Ellis and Deller's (1988) terminology. Use wear analysis indicated that the edges of 34 tools had been used for longitudinal cutting, while others were used for orthogonal cutting and direct penetration. The used tools exhibited bright polished surfaces. Storck and Tomenchuk (1990:77) speculate that some of the tools may have been used to split spruce roots. Replication and tool use experiments carried out by the authors suggested that "...the work performed with the tools in the Udora feature represent a substantial investment of time and effort".

In "Iroquoian Archaeology: It's the Pits" (Essays in St. Lawrence Iroquoian Archaeology, *Occasional Papers in Northeastern Archaeology* No.8 pp 1-7) Jim and Dawn Wright summarize the results of screening 27 tons of feature material salvaged from the St. Lawrence Iroquois Maynard/McKeown site. They report: "A utilized flake industry, hithertofore unrecognized in St Lawrence Iroquois culture, was represented by 97 chert, quartzite, and quartz specimens from 65 samples for an average of 1.5 per feature. These flakes, which include small split pebbles, were used and then discarded. Presumably, the abundant and elaborate bone tools and ornaments of St. Lawrence Iroquoian culture were fashioned with these simple expedient tools." (Wright and Wright 1993:4).

In “The Heritage Hills Site and Early Postglacial Occupation of the Ottawa Valley” (*Archaeology of Eastern North America* 2011 Vol. 39:131-152) Ken Swayze and Robert McGhee report an early postglacial period site in Ottawa on relict shorelines dated to 11,000 and 9,000 radiocarbon years ago. The assemblage of lithic tool is based on locally quarried vein quartz, and other poor quality coarse materials, primarily using a bipolar/anvil percussion technique. An experimental study of use wear on quartz tools was undertaken as the basis for recognizing used artifacts in the collection These unifacial tools, with crushing and use polish on steep edges and points, resemble those characteristic of Gulf of Maine Archaic Tradition assemblages in New England and the St. Lawrence Valley. Drafts of the paper in progress were sent to a wide variety of experts (see acknowledgements) and their comments, and those of the journal-selected reviewers, improved the paper. Also in 2011, the senior author presented a paper, by the same title, in the “David Sanger Session” at the Canadian Archaeological Association annual meeting in May in Halifax NS. Among the peers in Halifax were David Sanger himself other authorities of the Early Archaic, from the Smithsonian Institution and the University of Maine, who expressed their understanding of the nonbifacial toolkit based on expedient quartz tools. The same paper was also presented in the “Champlain Sea Session” at the Ontario Archaeological Association Symposium in November 2011, in Ottawa. The session was chaired by Adriane Burke (see above) who noted in his summary that, thanks to his work with Brian Robinson, he was aware of the technology and material used at Heritage Hills and sites like it.

The Heritage Hills site and other recently discovered sites suggest the existence of a previously unrecognized Early Archaic occupation of the Ottawa Valley and eastern Ontario. Over a period of 15 years from, 1991 to 2006, the consultant carried out 111 archaeological assessments in the Ottawa Valley that covered 1,493 ha (3,689 acres) of land slated for development. Given that many modern shorelines are already developed or protected from environmental disturbance, it is not surprising that these CRM study areas tended to occur on lands that are now high above, and at some distance from, modern shorelines.

The systematic survey of those years involved a sample of over 250,000 test pits, of which only about 1% produced stone artifacts and resulted in the identification of archaeological sites at 44 of the 111 locations tested. These positive test pits and find spots are clearly associated with relict shorelines and early postglacial landforms. On average about 100 stone artifacts were collected at each location. Initial surveys at these locations-excluding Heritage Hills, which produced a disproportionately high number of artifacts, yielded 4,666 stone artifacts. Further excavation at 22 of the 44 site locations produced an additional 10,163 artifacts.

The lithic technology practiced on the relict shorelines of the Ottawa Valley is characterized by the expedient use of whatever common stone material was available. Given that the region is in the Metasedimentary Belt of the Canadian Shield there is a wide variety of raw materials available at any given location. Chert and other cryptocrystalline materials are scarce and present only in the form of small pebbles or thin lenses, which were nevertheless used wherever they occurred. Materials selected for use were, in order of apparent preference: chert; quartz (preferably clear "hyaline" quartz); quartzite; felsitic granite; gneiss; schist, and even sandstone. Techniques of reduction include the bipolar/anvil percussion as well as flakes struck directly from cores or blocks extracted from veins and bedrock exposures. Core tools and cobble tools are present but most tools are made from minimally retouched flakes and spalls. In rare cases the retouched edges suggest a function, such as a chopper; scraper; perforator; or engraver, interpretations, which are widely accepted when applied to similarly shaped cryptocrystalline specimens (Swayze and McGhee 2011:148).

Andrefsky, W.

1994 “Raw Material Availability and the Organization of Technology” *American Antiquity* 59(1):21-34

Boksenbaum, M.W.

1980 “Basic Mesoamerican Stone-working: Nodule Smashing?” Lithic Technology v. 9(1):12-26.

Borden, C. E.

1960 “DjRi-3, an early site in the Fraser Canyon, British Columbia” *Contributions to Anthropology 1957*, National Museum of Canada, Bulletin 162:101-118, Ottawa.

1975 “Origins and Development of early Northwest Coast culture to about 3000 B.C.”, National Museum of Man, Archaeological Survey of Canada, *Mercury Series* No. 45, Ottawa.

Bourque, Bruce

2001 *Twelve Thousand Years: American Indians in Maine*. University of Nebraska Press, Lincoln NE.

Burke, Adrian

2006 Paleoindian Ranges in Northeastern North America Based on Lithic Raw Materials Sourcing. In *Notions de territoire et de mobilité: exemples de l'Europe et des premières nations en Amérique du Nord avant le contact européen*. ERAUL 116 (*Actes du Xe congrès annuel de l'Association Européenne des Archéologues, Lyon, 2004)*, edited by C. Bressy, A. Burke, P. Chalard and H. Martin, pp. 77-89. Études et Recherches Archéologiques de l'Université de Liège, Liège.

Burke, Adrian, Giles Gauthier, and Claude Chapdelaine

2014 Refining the Paleoindian Lithic Source Network at Cliche-Rancourt using XRF. *Archaeology of Eastern North America* Vol. 42 (2014), pp. 101-128

Callahan, E.

1987 “An Evaluation of the Lithic Technology in Middle Sweden during the Mesolithic and Neolithic” Aun 8:1-73 Societas Archaeologica Upsaliensis, Uppsala

Carlson Roy
1979 "The early period on the Central Coast of British Columbia" *Canadian Journal of Archaeology* v 3:211-228

Collins, Michael B.
1997 "The Lithics from Monte Verde, A Descriptive-Morphological Analysis" In, Tom D. Dillehay *Monte Verde a Late Pleistocene Settlement in Chile* vol. 2 The Archaeological Context and Interpretation, Smithsonian Institution Press, Washington and London

Cotterell, B. and J. Kamminga
1987 "The formation of Flakes" *American Antiquity* 52(4):675-708. Salt Lake City. Crabtree, Don E.

1972 "The Cone Fracture Principle and the Manufacture of Lithic Materials" *Tebiwa* Journal of the Idaho State University Museum 15(2):29-42, Pocatello, Idaho.
1973 "The Obtuse Angle as a Functional Edge" *Tebiwa* vol.16(1):46:53, Pocetello, Idaho.

Ellis, C.J. and B. Deller
1988 "Some Distinctive Palaeo-Indian Tool Types from the Lower Great Lakes Region" Midcontinental Journal of Archaeology vol. 13(2): 111-158, Kent State U Press.

Fladmark Knut
1990 "Possible Early Human Occupation of the Queen Charlotte Islands, British Columbia" *Canadian Journal of Archaeology* v 14:183-197

Grabert, G. F.
1979 "Pebble Tools and Time Factoring" *Canadian Journal of Archaeology* v 3:165-175

Hayden, B.
1981 "Research and Development in the Stone Age: Technological Transitions among Hunter-Gatherers" *Current Anthropology* v. 22(5): 519-548.

Kidd, K.
1948 "A Prehistoric Camp Site at Rock Lake, Algonquin Park, Ontario" Southwestern Journal of Anthropology vol. 4:98-106. University of New Mexico, Albuquerque.

Odell, George H.

1985 "Archaic Lithic Assemblages from the Stratified Napoleon Hollow Site in Illinois" *The Wisconsin Archeologist* 66(4):327-358

Petersen, James B. and David E. Putnam

1992 Early Holocene Occupation in the Central Gulf of Maine Region. In *Early Holocene Occupation in Northern New England*, edited by Brian S. Robinson, James B. Petersen and Ann K. Robinson, pp.13-62. Occasional Publications in Maine Archaeology, 9.

Robinson, Brian S.

1992 Early and Middle Archaic Period Occupation in the Gulf of Maine Region: Mortuary and Technological Patterning. In *Early Holocene Occupation in Northern New England*, edited by Brian S. Robinson, James B. Petersen and Ann K. Robinson, pp.63-116. Occasional Publications in Maine Archaeology, 9.

Sanger, D

1996 "Gilman Falls Site: Implications for the Early and Middle Archaic of the Maritime Peninsula" Canadian Journal of Archaeology vol. 20:7-28.

Storck, Peter L. and John Tomenchuk

1990 "An Early Palaeoindian cache of informal tools at the Udora site, Ontario" *Research in Economic Anthropology*, Supplement 5:45-93. JAI Press inc.

Swayze, J.K.

2006 "CIF P039-073 A Stage 1 and 2 Archaeological Assessment of Chalk River Laboratories, in Buchanan Twp. (Geo.) Renfrew County" report on file with OMCTS, Toronto.

2008 "CIF P039-115-2007 Archaeological Assessments at Chalk River Laboratories, Buchanan Township (Geo.), Renfrew County. Inventory of Known Cultural Resources, Cultural Resource Management Projects, Archaeological Predictive Model, and Master Plan" report on file with OMCTS, Toronto.

2010."PIF P039-138-2008 Archaeological Assessments at Chalk River Laboratories, Buchanan Township (Geo.), Renfrew County 2008" Report on file with OMCTS, Toronto.

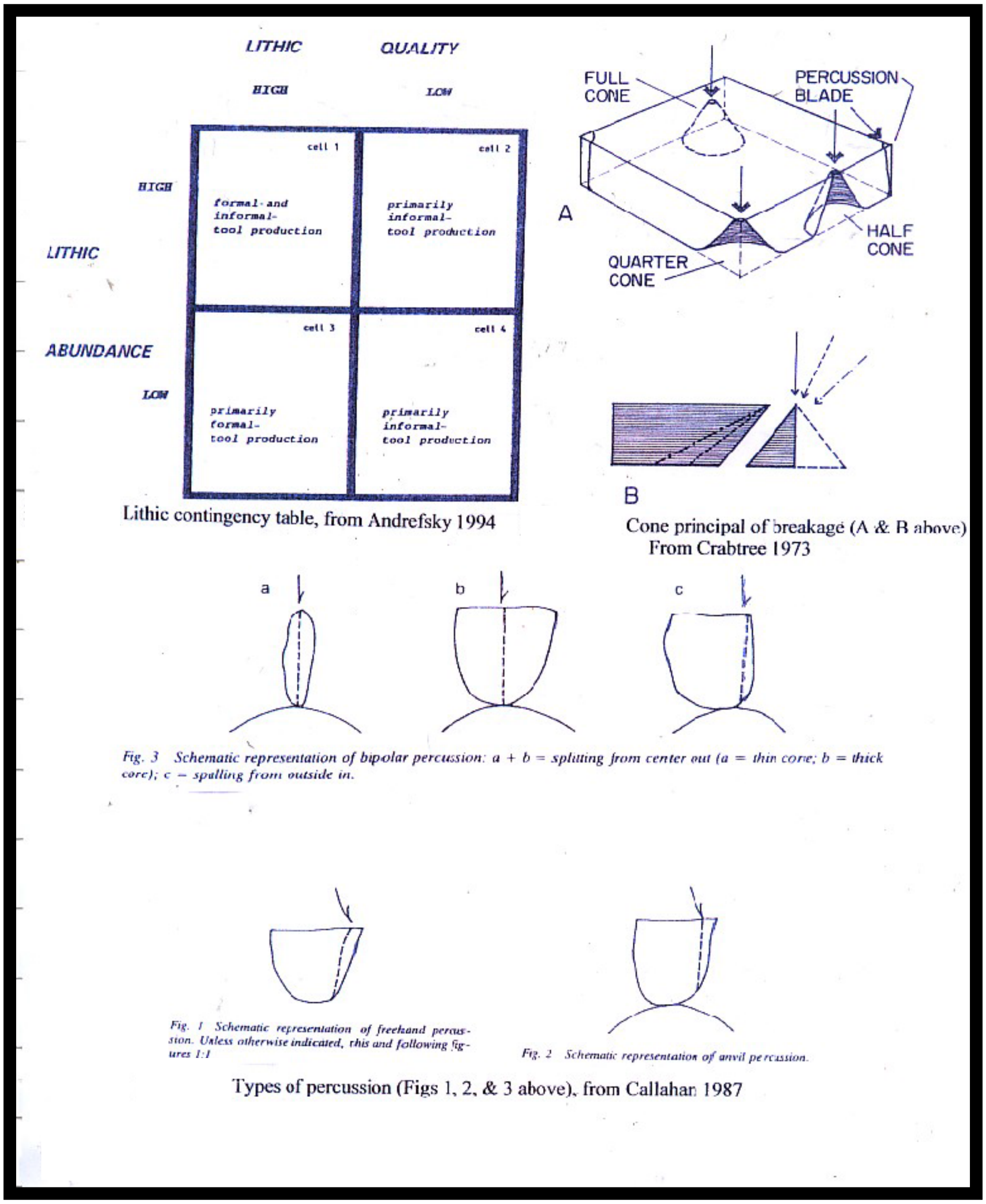
2011 PIF P039-155-2010 Archaeological Assessments at Chalk River Laboratories, Buchanan Township (Geo.), Renfrew County 2010" Report on file with OMCTS, Toronto.

2012 "PIF P039-172-2011 A Stage 2 Archaeological Assessment of Wood Pole Replacement Locations on D6 115 kV hydro corridor", report on file with OMCTS, Toronto.

Swayze, Ken and Robert McGhee
2011 "The Heritage Hills Site and Early Postglacial Occupation of the Ottawa Valley" *Archaeology of Eastern North America* v. 39:131-152; Eastern States Archaeological Federation.

Wright J.V.
1995 "History of the Native People of Canada, vol. I" Archaeological Survey of Canada, *Mercury Series* Paper 156. Canadian Museum of Civilization. Gatineau

Wright, J.V. and D.M. Wright
1993 "Iroquoian Archaeology: It's the Pits" In, J.F. Pendergast and C. Chapdelaine (eds.) *Essays in St. Lawrence Iroquoian Archaeology, Selected Papers in Honour of J.V. Wright,* Occasional Papers in Northeastern Archaeology No. 8:1-7, Copetown Press, Dundas Ontario.



Lithic contingency table, from Andrefsky 1994

Cone principal of breakage (A & B above) From Crabtree 1973

Fig. 3 Schematic representation of bipolar percussion: a + b = splitting from center out (a = thin core; b = thick core); c = spalling from outside in.

Fig. 1 Schematic representation of freehand percussion. Unless otherwise indicated, this and following figures 1:1

Fig. 2 Schematic representation of anvil percussion.

Types of percussion (Figs 1, 2, & 3 above), from Callahan 1987

Figure 1: Signs of percussion, Gulf of Maine Archaic Tradition

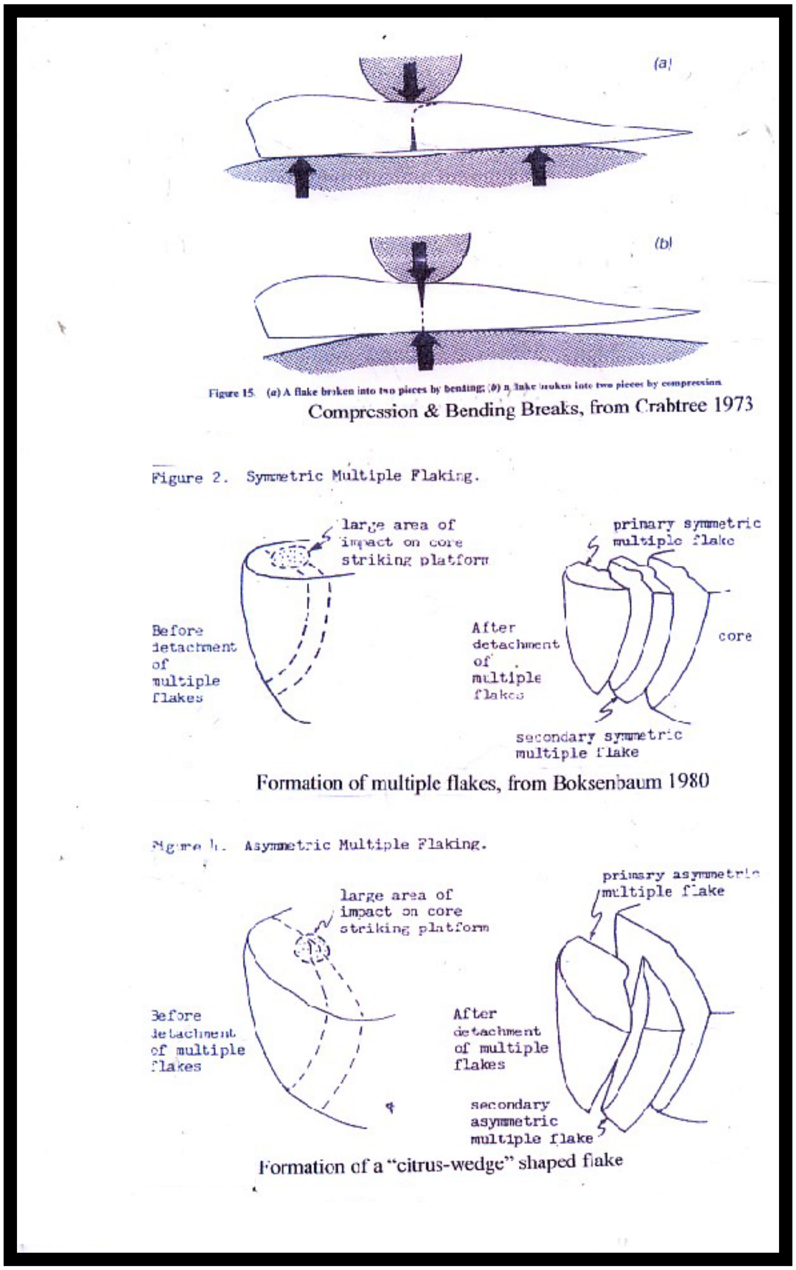


Figure 2: Signs of percussion, Gulf of Maine Archaic Tradition

Appendix B - Separately Bound Supplementary Documentation

Due to the locational information found in the following figures and attachments they are bound in Appendix B and filed separately with the Ministry of Tourism, Culture, and Sport.

- **Figure 4: Map showing the areas of concentration that were subjected to stage 4 mitigation within the NSDF.**
- **Figure 5: Site map of CaGi-65 Station I**
- **Figure 6: Site map of CaGi-65 Locale J**
- **Figure 7: Site map of CaGi-65 Station Q**
- **Figure 8: Profile of CaGi-65 Station I**
- **Figure 9: Profile of CaGi-65 Locale J**
- **Figure 10: Profile of CaGi-65 Station Q**
- **Figure 11: Site map of CaGi-66 Locale A**
- **Figure 12: Profile of CaGi-66 Locale A**
- **Figure 13: Site map of CaGi-66 Locale A**
- **Figure 14: Profile of CaGi-66 Locale A**
- **Figure 15: Grid map of CaGi-67 Locale F**
- **Figure 16: Grid map of CaGi-67 Locale I**
- **Figure 17 Grid map of CaGi-67 Station X**
- **Figure 18: Profile from CaGi-67 Locale F**
- **Figure 19: Profile from CaGi-67 Locale I**
- **Figure 20: Profile from CaGi-67 Station X**
- **Catalog**

APPENDIX C - GLOSSARY OF TERMS

Archaic Period: Defines a culture with particular adaptations and technological attributes that existed between 9,500 and 2,900 years ago in Ontario.

Archaeological Potential: The likelihood that the property contains archaeological resources.

Archaeological Resources: Defined by the Ontario Ministry of Tourism and Culture Standards and Guidelines for Consultant Archaeologists as objects, materials, and physical features identified by archaeologists during a stage 2 archaeological assessment as possibly possessing cultural heritage value or interest. Analysis using the criteria set out in the Standards and Guidelines determines whether those objects, materials, and physical features meet the definition of an archaeological sit under the Ontario Heritage Act and whether stage 3 archaeological assessment is required.

Archaeological Site: Defined in the Ontario regulation as "Any property that contains an artifact or any other physical evidence of past human use or activity that is of cultural heritage value or interest".

Artifact: Defined in the Ontario regulation as "any object, material or substance that is made, modified, used, deposited or affected by human action and is of cultural heritage value or interest".

Cultural Heritage Value or Interest (CHVI): For the purposes of the Ontario Heritage Act and its regulations, archaeological resources that possess cultural heritage value or interest are protected as archaeological sites under Section 48 of the act. Where analysis of documented artifacts and physical features at a given location meets the criteria stated in the Standards and Guidelines, that location is protected as an archaeological site and further archaeological assessment may be required.

Diagnostic Artifact: An artifact that indicates, by its markings, design or material, the time period in was made, the cultural group that made it , or other data that can identify is original context.

Expedient (Informal) tool: Most often a stone artifact with no particular form or design indicating the reason it was made.

Formal tool: Most often a stone artifact with a form or design that indicates the reason it was made, like a stone spearpoint or hide scraper. Contrasted with informal tool, like a chert flake used for cutting.

Geochronology: The age or date is determined by the geological formation.

Grid: A two-dimensional series of regularly spaced locations across an archaeological site or other area, often at either one-, five- or ten-metre intervals.

License: In Ontario, archaeological work can only be undertaken by people who have been granted the appropriate license by the Ontario Ministry Tourism and Culture.

Lithic: Made of stone

Lithic Scatter: A loose or tight concentration of stone flakes and tools resulting from the manufacture and sometimes the use of one or more stone tools.

Paleo-Indian Period: Defines the earliest culture of the first people to occupy the land that was exposed after de-glaciation. In Ontario, the earliest Paleo-Indian sites date between 11,000 and 10,500 years old.

Piece-plotting: The process of recording the precise three-dimensional location of each artifact as found within an an archaeological site, or a part of an archaeological site.

Post Contact Period: The time period following the date Europeans made first contact with North American Indigenous peoples. The date differs across the province.

Pre-Contact Period: The time period before the date Europeans made first contact with North American Indigenous peoples.

Project Information Form (PIF): The form archaeological license holders must submit to the Ministry of Tourism, Culture and Sport upon deciding to carry out fieldwork.

Test Pit: A usually round hole between 30 and 50 cm in diameter dug to subsoil at regular intervals along a survey transect. The excavated soil is sifted through 6 mm mesh to look for artifacts.

Test Unit: A square hole, 1m by 1 m in its horizontal dimensions and of variable depth, excavated according to certain standards.